December 1980

Smithsonian

Renaissance clockworks
were gifts of royalty (p.44);
here, a gilded rooster
from dazzling new display

3:06 P.M.

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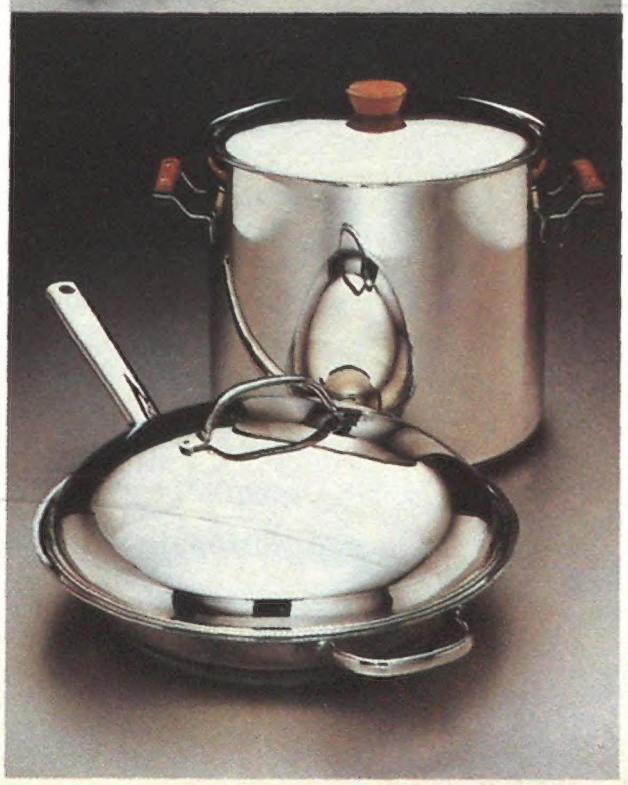

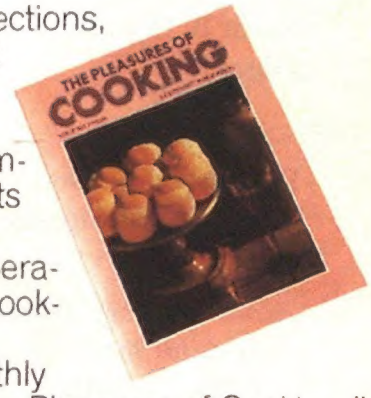

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Smithsonian

Volume 11, Number 9

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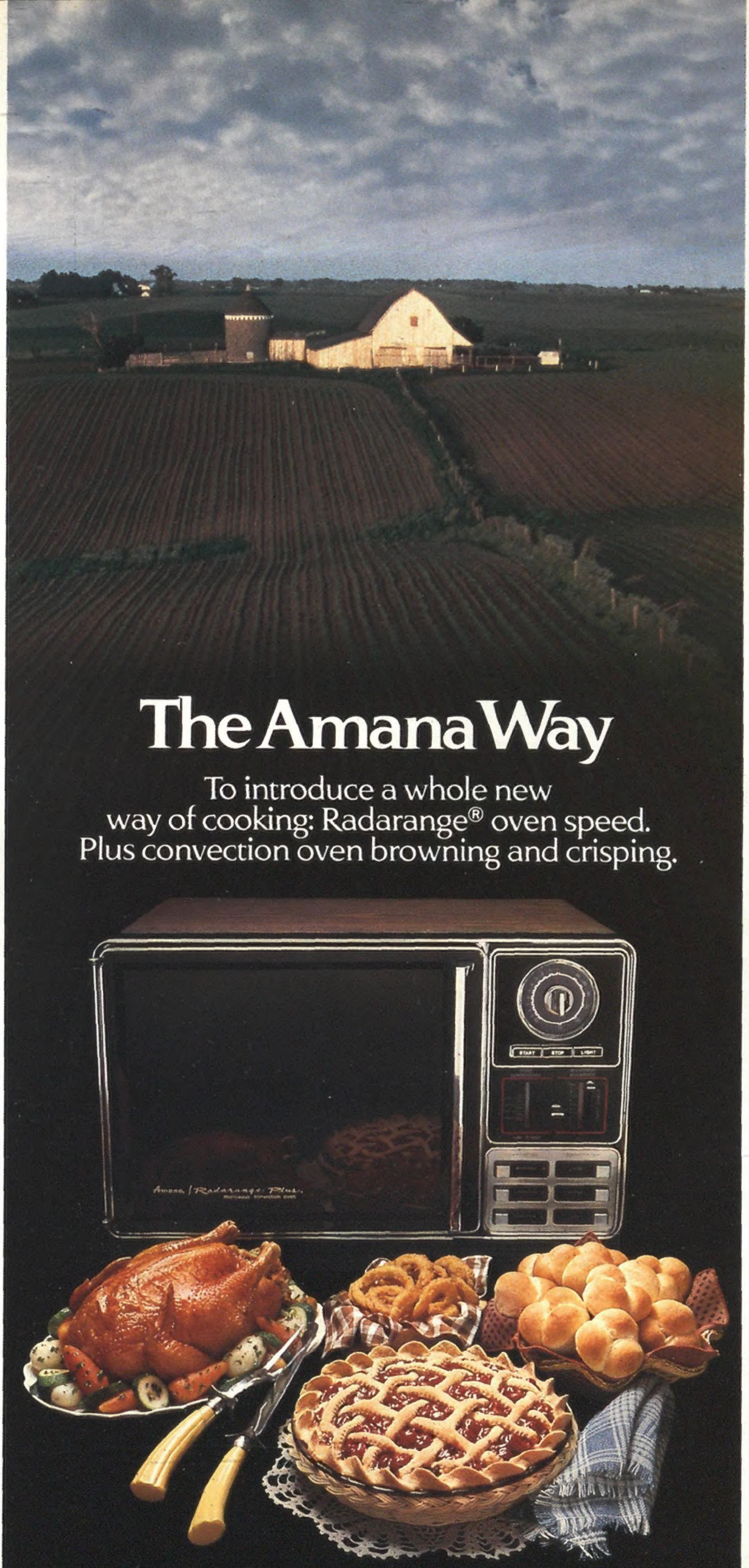

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Secretary Ripley's comments

The view from the castle

An architecturally innovative building on Bermuda's Ireland Island deserves to be rescued from its current state of neglect

One of the quaintest and most nostalgic parts of Bermuda, those delightful and airy isles off our shores, is the Royal Naval Dockyard and its new Bermuda Maritime Museum. The Royal Navy's interest in Bermuda dates back to the late 18th century when, following the American Revolution, Britain was left without a naval base between Halifax and the West Indies. The sheltered roadstead within the "fishhook" at the western end of Bermuda was a safe anchorage from which British vessels could sally forth to intercept French privateers attacking shipping between Canada and the West Indies.

This was the beginning of the great naval base on Bermuda, which was maintained through the 19th century and two World Wars until 1953, when it was turned over to the Bermuda government. In the intervening century and a half, dockyard and shore facilities were developed. These include a huge complex of stone buildings with—from today's point of view—beautiful details: twin towers 100 feet high, looking from a distance like London church steeples, and warehouses with graceful arched entrances.

Overlooking all this, from a lofty hill on Ireland Island, is a grand but derelict building known as the Commissioner's House (opposite). Built as a "suitable residence" for the Commodore Superintendent of the Dockyard (the Commissioner), it was begun in 1823 but not completed until 1832, thanks to a series of stops and starts by the Lords of the Admiralty. The uproar was all about the costs (£42,511, more than $200,000). One reason was the lavishness of the place: it had a marble bathtub with three faucets, for cold water, hot water and salt water; a ballroom called the "wardroom"; fine paneling and plasterwork; and stabling for 11 horses and two carriages, even though there were no roads on the island.

The other reason for the cost was that it employed a then still novel method of construction: cast iron throughout, instead of timber, for the structural elements. With verandas and balconies overlaid with Yorkshire paving stone, the result was thought to be fireproof.

The building was occupied by the Commissioner for only ten years, after which it served a variety of uses. But by 1953, when the handing-over to the Bermuda government had taken place, the great Commissioner's House was a misfit, an object of curiosity to light-fingered vandals. It was fated to be so treated for years, until in 1974 the Bermuda Maritime Museum was organized to administer the Dockyard establishment, and the house on the hill could be protected.

Unfortunately, the Museum's receipts (from 40,000 visitors a year) are not sufficient to undertake the renovation of this extraordinary building.

Probably $2 million would be needed to restore the house—which would make an admirable historical and folk museum; at the same time, the complex could be used to house visiting North American naval cadets and youth groups. Since the majority of Bermuda's tourists are from the American mainland, perhaps the necessary support could come from the traditional generosity of American philanthropy and business. The house is worth it!

S. Dillon Ripley

The House, with its slender columns and delicate ironwork, as it appeared in the 19th century.

The building's present ramshackle state is due to years of vandalism and weather exposure.

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A Detroit Cadillac owner helped police identify his stolen car by remembering *birdseed* spilled under the back seat. (The thief is now roosting in the federal coop.)

Your business card, dropped down window channels into doors or secreted in places only *you* will remember, will serve the same purpose.[2] And even simpler than "signing" your car is locking it.

In Boston, for example, where 1 out of every 35 cars was stolen in 1975, a "Lock-your-car" campaign run by the National Auto Theft Bureau helped cut theft 26% in two years.[3]

One last word of advice. Before you buy the expensive options that'll make your car *more* attractive to car thieves, buy the anti-theft device options that'll make it less attractive.[4]

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[1]Auto theft is no longer a "cottage industry": it's a huge racket that costs the American people $2 billion a year.

[2]The National Auto Theft Bureau also suggests: using a vibrator pencil, etch the vehicle identification number in several hard-to-find spots. Use your imagination: the more unique your hiding place, the more exasperating to a thief!

[3]About 20% of stolen cars are driven away with the keys the owner left *in the ignition;* in another 20%, keys are transparently "hidden" above the visor, in the glove compartment or under the driver's seat. Locking your car won't protect it from a professional thief, but it will protect it from the joy-riding teenagers who account for many thefts.

[4]These devices only slow down a professional thief, but the more time it takes him, the more chance he'll be caught. Locking systems, cut-off switches and security alarms are all available at auto supply stores.

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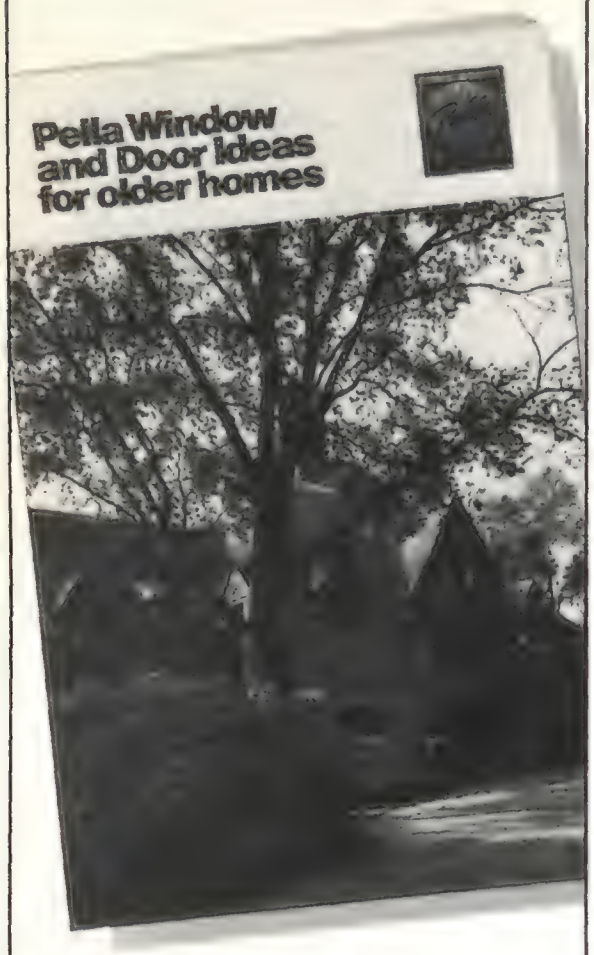

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Letters to the Editor

Revival of modern dance

Dear Sir: Walter Terry's article in the October issue on saving modern dance masterpieces reminded me of a wonderful friend and international expert on dance notation, Dr. Juana de Laban. She was the daughter of Rudolf von Laban and a personal friend of Ruth St. Denis. During the last three years of her life, Dr. de Laban worked tirelessly to make sure that Labanotation, described in your article, could be used easily by anyone who wanted to record human movement. An expert in dance history, she also knew the importance of saving dances for future generations.
Patricia K. Benoit
Temple, Texas

Dear Sir: As a former member of the Denishawn Dancers from the Orient tour in 1925 through the Ziegfeld Follies tour of 1928, as well as the author of two books covering the Denishawn Golden Era, I would like to say that I share Walter Terry's reservations about the viable recreations of St. Denis-Shawn dances as presented by the Repertory Dance Theatre (RDT) of Utah.

On the cover, the broadly smiling figure stands out in an exhibitionistic way from the over-large cape veil in what I consider a vulgarization of any scarf dance ever created by Ruth St. Denis. Miss Ruth herself never appeared in a completely unadorned leotard. And when she so costumed her Denishawn Dancers, her delicate lighting was dictated by the mood of the dance.

The great difficulty in reviving Denishawn creations, as I see it, is the break of continuity between the last performance of a work by the company and its much later reconstruction by those dancers who must, perforce, *imagine* what the dance was really like.

If, as they say, the RDT dancers truly want to search out "every possible source of information," I suggest they start with Barton Mumaw, the leading dancer in Ted Shawn's Men Dancers who has recreated *Kinetic Molpai* for the Alvin Ailey and Norman Walker groups. And, if I may be immodest, they should read my book, *The Drama of Denishawn Dance*, in which I describe 56 of the most famous works choreographed by Ruth St. Denis, Ted Shawn and Doris Humphrey (while she was with Denishawn).
Jane Sherman
New Paltz, New York

Dear Sir: I would be amazed if Ruth St. Denis did not acknowledge her debt to the American, Loie Fuller (1862-1928), for the scarf dance shown on your cover. The drawing [see below] is from London's *Tattler* of October 7, 1903. In her day, Loie was just as famous as Isadora Duncan, and equally deserving of credit for creativity in modern dance.

John E. Tuhy, M.D.
Portland, Oregon

Dear Sir: If anyone but Walter Terry had written the article on dance, the omission of Loie Fuller might be understandable.

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But, in a book he coauthored with Jack Rennert, *100 Years of Dance Posters*, was this statement: "This dazzling creature of the theater too often overlooked by her fellow Americans, was not dismissed by the two great American dancers, Isadora Duncan and Ruth St. Denis. Indeed, Isadora wrote of her on seeing her for the first time at the turn of the century, she is 'a luminous vision . . . the sorcery of light, color and flowing form. What an extraordinary genius!' And St. Denis, late in life, commented: 'Where would the theater dancers of today [be] without Loie's magnificent contributions?' "

Lucy Broido
Bryn Mawr

Dear Sir: Amusingly, cover girl Rachel Nelson, who was performing Ruth St. Denis' scarf dance, became a new entity —"Ruth Nelson"—in the cover credits. But we are sure that all who see her dance will remember her as Rachel Nelson, incarnating the motion if not the name of Miss Ruth.

Kay Clark
Repertory Dance Theatre
Salt Lake City

Dolphins

Dear Sir: In Michael Parfit's article on dolphin research, a single theoretical investigative statement is featured as my fixed belief rather than a theory to be tested. The key part of the quote is: "I invite you to entertain some new beliefs. . . ." I did not invite anything more than entertaining beliefs, not necessarily taking them on as reality. We and others mentioned in the article are testing the possibilities of communication with dolphins; entertaining the belief in their intelligence motivates us to try the tests.

I refuse to predict the outcome of our experimental work. The methods are too new and the experiments in progress too recent for comment. There is too much to do for any one lab; I am glad to see several new persons in the field. In the Fifties and Sixties, there were fewer researchers interested in communication with and between dolphins. I believe there is now a viable scientific field, which was begun in 1960 by us at the Communication Research Institute in the U.S. Virgin Islands and in Miami, Florida.

John C. Lilly, M.D.
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Dear Sir: Dr. Gish's statement that "Dolphins are unique among mammals" and "We shouldn't confuse their behavior with human behavior" cannot be emphasized enough. We must always remember that dolphins are not people, but it is up to us to keep their ocean home safe.
Heidi Beck
Gilmanton, New Hampshire

Dear Sir: Michael Parfit's article on dolphins brought back memories of my college days on the Gulf Coast when I served as a crewman on a shrimp boat.

One of my chief duties, since I was an accomplished marksman, was to hang in the boat's rigging with an army carbine in one hand just prior to lifting the huge purse seine from the water, and fire warning shots at dolphins that came close—a common practice along the Gulf in those days. I was also instructed to shoot to kill if the dolphins got too close. The skipper's rationale in giving such orders was a tribute to cetacean intelligence. The net was tied in a slipknot to facilitate dumping the catch on deck, and the dolphins, knowing that untying the knot would result in a feast, had learned to do just that.

Lest one think too harshly of the shrimpers, it must be realized that their catch represented a substantial sum, even in 1960. Since the dolphins haven't got any dumber and the price of shrimp has certainly increased, I suspect that dolphins are still being shot at.
Charles Q. Cutshaw
Asheville, North Carolina

Dear Sir: A scant three weeks after you featured her with me on the last page of your dolphin article, Longnose died after a brief illness. Through her five years of close relationships with the people at Flipper's Sea School, she had evolved a real desire of her own to reach out. She readily caught on to novel concepts, ever more complex, and grew more proficient every day to the delight of all who watched her at work and play. To us, Longnose was much more than just a captive dolphin or a trained animal.
Carol Smith
Marathon Key, Florida

Peterson's Field Guide

Dear Sir: I am looking forward to acquiring Peterson's 1980 bird guide. His books

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have gone with me on my travels through the United States and Europe.

Five years ago I came to birding as a backyard observer. A need for some sort of guide to identify the many species flitting through my garden came to me in the form of a book titled *Fifty Birds of Town and City,* published by the U.S. Department of the Interior. It is a joy for the beginner because it brings instant identification. From there, the birder can move, as I did, to the classic guide of Roger Tory Peterson.

Ann S. Jablin
Skokie, Illinois

Twins

Dear Sir: The article on identical twins by Donald Jackson was fascinating. As a lifelong student of genetics, a father of seven children both adopted and natural (two mothers), and the grandfather of identical twins now grown, I have long been convinced that genes play a dominant role in physical, mental and personality traits. The similarities between identical twins cited in the article are not "astonishing" to me, although I'm sure they will be to many people. I'm content to let the evidence speak for itself.

Leon S. Minckler
Blacksburg, Virginia

Dear Sir: Your article on the twins should be of interest to all parties in the adoption triangle. It certainly does lend credence to the arguments favoring heredity over environment.

It is indeed unfortunate that in many states the records pertaining to adoption are sealed—even for those adults who were adopted as young children. Legitimate research into the many problems relative to adoption, as well as heredity, among those adopted is severely lacking. We sincerely hope that Dr. Bouchard's work and other efforts will begin to shed light on many of the problems that have long puzzled adoptees.

Leslie S. Waguespack, President
Adoptees' Birthrights Committee
Metairie, Louisiana

Explorers Club

Dear Sir: I was upset with you for including an article on a sexist organization—namely the Explorers Club. That "The club does not admit women to member-

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ship" is clearly stated, but it seemed to be buried well into the article. I doubt that you would have made such an equally insulting statement if the club did not admit blacks, Chinese or Mexicans.

Barbara Scheifler
Berkeley, California

On October 21, the Board of Directors voted to recommend to its 3,000 members that women be allowed to join the Explorers Club. A vote of approval is expected within the next few months. Ed.

Los Angeles oil boom

Dear Sir: In your article on the Los Angeles oil boom, the reference to the Southern Pacific and Santa Fe railroads switching to oil fuel leaves the impression that this did not happen until the turn of the century. Actually, engine number ten of the California Southern (a Santa Fe subsidiary) was fitted with a burner in October 1894. By November 17, 1894, this engine with a redesigned burner was in road service over the Cajon Pass, and by January 12, 1895, the California Southern (Santa Fe) had three oil-burning engines working.

There can be no reasonable doubt that the Doheny strike triggered the first *real* oil boom in Los Angeles County. However, the article does not mention the almost 30 years of oil activity in Southern California that antedated Doheny's strike—giving the impression that it all began in 1892.

W. H. Hutchinson
Chico, California

Dear Sir: I would like to point out that Signal Hill is not south of Long Beach—it is northeast of downtown. Visitors are often unbelieving, but in Long Beach the Pacific Ocean is due south. There were no wells in the ocean in those days.

Signal Hill had been a fine residential area before oil was discovered. My mother and sisters used to pick armloads of calla lilies on the hill to decorate our church for Easter Sunday. Soon the oily mess killed the lilies.

Living near an oil field had its dramatic moments. There were gushers that caught fire throwing flames into the sky. Other gushers were mud—tons of it. Once a refinery exploded near our home, blowing in all the windows.

Dorothy Humphreys
White Heath, Illinois

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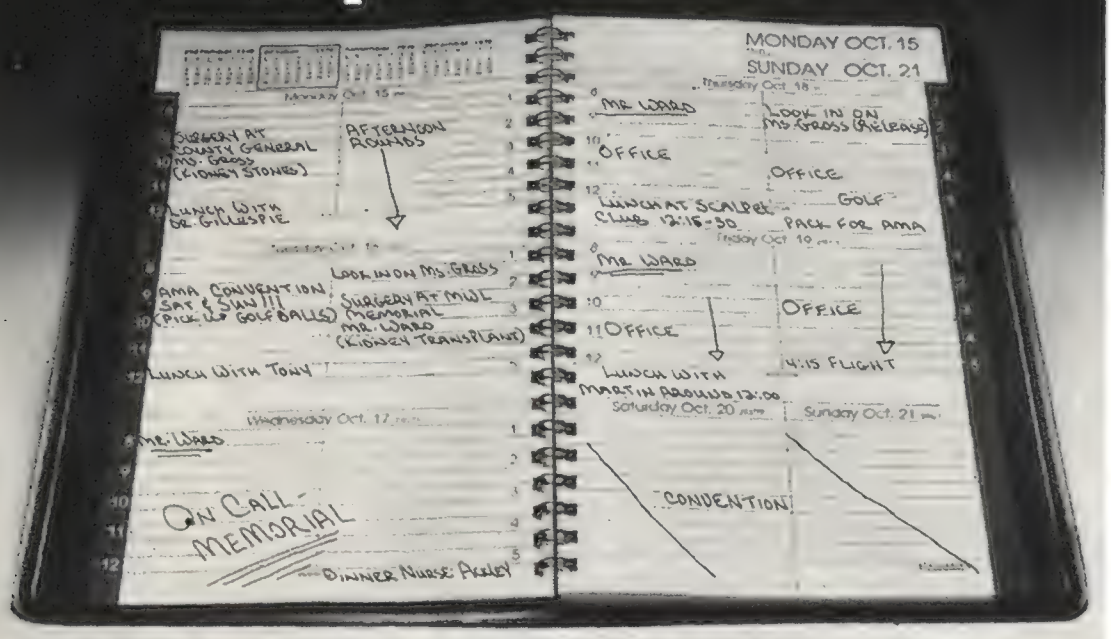

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Phenomena, comment and notes

The battle over saccharin has been going on for years, and raises a basic question: What do we really want?

It was a showdown right out of the movies. Standing in the President's office, the government's chief food and drug regulator faced men he collectively called the "interests": Congressmen, food processors and lawyers who had sought the confrontation. Could the government tell them what to do, what they could put in food and what they could not?

The President asked the questions. First on the agenda was benzoate of soda, a preservative that catsup makers said they had to have or they would be forced out of business. The President turned to the regulator: What did he think about the suspect preservative?

"Mr. President, I don't think; I know by patient experiment that benzoate of soda or benzoic acid added to human food is injurious to health."

As the regulator described the scene later, the President slammed the table in front of him with his fist and, showing his teeth, said to the delegation:

"This substance that you are using is injurious to health and you shall not use it any longer."

The regulator had won the first round, he thought. But there was one to go. A Congressman in the room asked about saccharin, saying his company saved $4,000 a year using saccharin instead of sugar to sweeten canned corn. The regulator attacked:

"Everyone who ate that sweet corn was deceived. He thought he was eating sugar,

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Dr. Harvey W. Wiley, first enforcer of the nation's food and drug laws, weighs food portions for his "Poison Squad," volunteers on whom additives were tried.

when in point of fact he was using a coal tar product totally devoid of food value and extremely injurious to health."

The President turned to him in sudden anger.

"You tell me that saccharin is injurious to health?"

"Yes, Mr. President, I do tell you that."

"Dr. Rixey gives it to me every day."

"Mr. President, he probably thinks you may be threatened with diabetes."

Purple with anger, fists clenched, hissing through his teeth, the President cried: "Anybody who says saccharin is injurious to health is an idiot."

With the regulator bitterly opposed to saccharin, the situation was awkward. The President solved the problem the very next day by creating a five-man scientific referee board to pass on such decisions. Its chairman? The chemist in whose laboratory saccharin had been discovered 29 years before. The board overruled the regulatory agency and saccharin was allowed to remain in canned corn—but only for a while.

Saccharin has been controversial for a long time. The President who felt so strongly about the substance was Theodore Roosevelt; the Congressman/corn canner (later to be Vice President) was James S. Sherman; and the regulator was my grandfather, Harvey W. Wiley, chief

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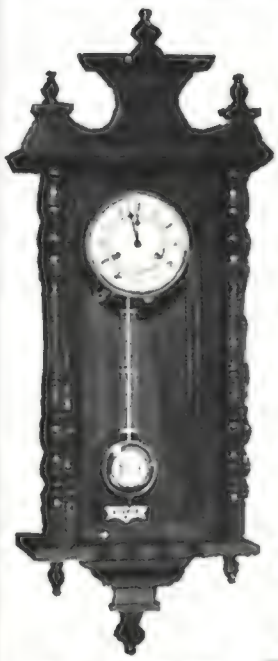

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of the Department of Agriculture's Bureau of Chemistry, charged with enforcing the new Pure Food and Drug Act of 1906.

When my grandfather referred to his "patient experiments" with benzoate of soda, he did not mean random patients. He meant he had fed benzoate of soda to 12 volunteers known in the newspapers as the "Poison Squad," and decided it made them sick. As it turned out, the President's new review board promptly reversed Roosevelt's own decision and benzoate of soda stayed.

Ira Remsen, Johns Hopkins chemistry professor (later to be president of that university—and chairman of the review board), synthesized saccharin in 1879. It has no nutritional value and passes through the body unchanged. You could say it is useless, except that pound for pound it is about 300 times sweeter than sugar. Seventy years ago, canners and soft-drink bottlers used it not to reduce calories in their products, but simply because it was cheaper than sugar.

In 1912 the federal government did ban saccharin from general food use as a "poisonous or other added deleterious ingredient," and tried to restrict its use to those with medical need. It could be used in foods that carried a special label saying that the product was intended for people who, on account of disease, had to abstain from sugar. Food processors seized on the review board's ruling that more than 3/10 of a gram a day could be harmful. Anything less, they maintained in advertisements, was OK. Wiley, who left the government in 1912 but kept up the fight in the pages of *Good Housekeeping*, called this a "perversion" of the law. But then he was never shy in his crusade for pure food—and honest labeling. He publicly referred to Congressman Sherman as "Short-Weight Jim."

The question of carcinogenicity was raised around 1970 and for the past ten years we've been struggling with that issue. For diabetics and others who must avoid sugar, saccharin can satisfy craving for a sweet taste. In fact, the whole controversy can be turned upside down if we listen to those, some doctors included, who wonder whether the 100 or so pounds of refined sugar the average American eats every year is not more injurious to health than saccharin, even with the possible cancer risk. (The Food and Drug Administration did review the

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scientific evidence on sugar in 1978; it found nothing alarming.)

Most people who use saccharin today do so to reduce their caloric intake. Many of these people are teen-agers, and they take most of their saccharin in soft drinks. Three-quarters of the five million pounds of saccharin we consume in a year is in diet soda; dietetic food uses some 15 percent, and most diabetics also use it.

But there may be a Catch-22 in using saccharin to cut calories. A 1947 study suggested that as little as 50 milligrams of saccharin, the amount in one-third of a bottle of soda, lowers blood sugar by about 16 percent. Such a drop can trigger the appetite, so the soda drinker may eat more. At the very least, studies devised so far show no correlation between saccharin use and weight loss. Nor, one blue-ribbon study adds, can it be demonstrated as useful in the treatment of patients with coronary artery disease or even diabetes.

Well, what about cancer? In a famous 1977 study in Canada, rats were fed saccharin in amounts equivalent to that in 800 bottles of diet soda a day for humans, and a significant number developed bladder cancer. The results were ridiculed by many because of the doses, and so the question seemed to remain open. So how do we find out if saccharin really can cause cancer?

The answer is that we are the rats. If saccharin is a carcinogen in humans, and it appears to be a weak one, it will produce some additional cases of cancer after long periods of use. (In proposing a ban in 1977, then FDA Commissioner Donald Kennedy estimated that lifetime ingestion of saccharin by the general population could lead to 1,200 new cases of bladder cancer annually.) In testing for such a weak effect, it is standard practice to use high doses on laboratory animals to make the effect visible in a limited test population. (Demonstrating that something causes cancer in animals does not prove it causes cancer in humans. But most of the compounds that are carcinogenic in humans are also carcinogenic in experimental animals.)

Heavy smokers generally take 30 years to develop lung cancer (not all do, of course). Saccharin has been in heavy use for only a decade, since the cyclamates were taken off the market. So if it does cause cancer, we may not see cases for another 10 or 20 years, and when we do we will not be sure

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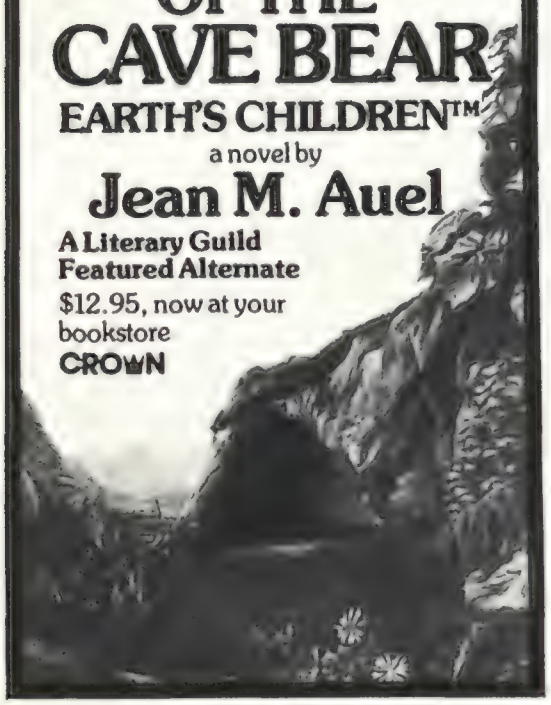

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what caused them. If we're going to study this issue and we want to know in just a couple of years, we need rats. But do we want to know?

We may never feel we know for sure, at least not at the rate things are going now. What to do? Here's Dr. Robert Hoover of the National Cancer Institute, in an editorial this year in the *New England Journal of Medicine*:

"When all the evidence of toxicity is weighed against the lack of objective evidence of benefit, any use by nondiabetic children or pregnant women, heavy use by young women of childbearing age and excessive use by anyone are ill-advised and should be actively discouraged by the medical community."

I'm not worried, because I don't drink diet soda or eat diet foods. I do worry quite a lot about the cigarettes I smoke every day. Smoking is blamed for more than 70,000 new cases of lung cancer a year in the United States, and for contributing to some 250,000 new cases of heart and lung disease. Much more impressive numbers than the trifling 1,200 projected for saccharin. But nobody's going to take away my cigarettes: the government's not going to ban tobacco.

My grandfather, known in some quarters as Old Borax, had no use for caffeine (he spent his honeymoon in Chattanooga, testifying against Coca-Cola) much less tobacco. He thought the government should enforce its own law and keep "deleterious substances" out of the nation's food and drugs. He was on the right side then: those were the days when you could buy soothing syrups for crying babies that contained morphine and opium. He was probably right about saccharin, too. But it seems that Congressman Sherman was right, too, 72 years ago: do we want the government to tell us what to do?

It really is up to us. When the FDA proposed a ban in 1977, Congress stepped in and declared a moratorium. It was the first time in history the Congress had legislated on an individual chemical under the Food, Drug and Cosmetic Act. The moratorium has been extended to June 30, 1981. The fundamental question is this: Assuming that saccharin is a weak carcinogen, as new studies during the moratorium period have confirmed, should the government ban it or simply inform us and let us decide what we want to do about it?

—JOHN P. WILEY JR.

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Around the Mall and beyond

Without entirely revealing its antiquity, let me admit that my generation received in school a pretty good dose of 19th-century literature. Consequently, we have an instinctive vision of the typical 19th-century child, bolstered by many artists and illustrators. It was invariably a bright-eyed little thing with pink cheeks and rosebud lips.

So what are these little horrors (below) doing in an exhibit of the works of a mid-19th-century American artist? They provide, it appears, an alternative view of childhood—and of the world that made them that way. The view is that of David Gilmour Blythe, America's foremost 19th-century satirist, a strange, brilliant, moralistic, bad-tempered, bitter,

Butler Institute of American Art, Youngstown

Blythe's *Street Urchins,* (1856 to 1858): a bitter comment on city childhood.

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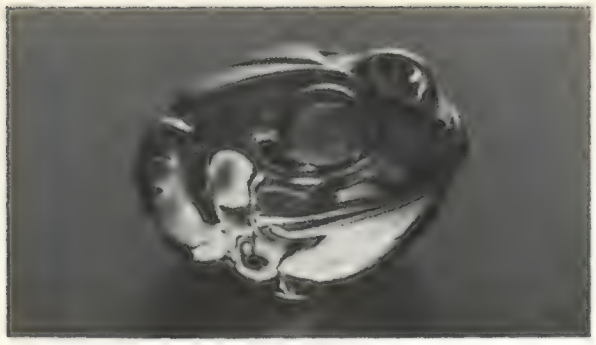

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outrageous, uncomfortable painter and poet. His works began gracing the National Museum of American Art in October, at the same time the museum began calling itself that instead of the National Collection of Fine Arts.

Blythe lived from 1815 to 1865, a half-century when the United States was expanding too fast for its looks, as my father's friend Slocum used to say about teen-age boys in the pimple stage. Blythe saw, perhaps all too clearly, the grotesqueries of his time and the forces he felt caused them: greed, corruption, folly and hypocrisy, for starters. He teed off on all these evils in his darkly ominous paintings, allowing himself to slip into caricature to make his point. Hence the street urchins of Pittsburgh, dough-faced, sour-eyed, puffing at their wretched cigars.

Bruce Chambers, Director of the University of Iowa's Museum of Art and visiting curator of the Blythe show at our newly renamed museum, writes: "Every one of these vagabond children is engaged in an act of idleness, mischief, or crime. . . . All show the marks of poverty or neglect in the unrepaired elbows and knees of their clothing, but few possess the charm of rusticity by which such costumes were conventionally tempered. Most importantly, these are tough kids, sly, wicked, fearful, inured to circumstance. To explain their appearance in Blythe's world, one must turn to the social context in which they were created and to which they were addressed, that is, to the city of Pittsburgh and the patrons of Pittsburgh's art."

Chambers, author of the excellent essay that serves as a program for the Blythe show, wrote to me about the show, and I shall quote from his comments at length, not always with direct attribution. He says that Blythe's cold, hard look at society in an expanding, tumultuous mill city, Pittsburgh, marks him as a most unusual artist in an age when so many were painting glorious views of mountains and rivers, framed in sun-etched clouds. And equally strange was the fact that Blythe's caustic commentaries were bought by the very industrialists who caused the problems—Andrew Carnegie's coterie. They thought Blythe was great.

The artist was not always so embittered. "He had once been high-spirited and adventuresome," says Bruce Chambers, "fond of sketching exaggerated cartoons of his friends and fond as well of writing romantic verses in the cause of courtship." But in 1856 he returned to Pittsburgh, where he had begun his career 25 years earlier, battered by the sudden death of his wife and the failure of an ambitious artistic project, a huge panorama of the Alleghenies. He blamed the world for his misfortunes and found in Pittsburgh an inexhaustible supply of material for his pen and brush to attack.

The city's mills operated day and night, "covering it with such an impenetrable cloud of soot that visitors were reminded of the smoldering fires of Hades." Yet its industrial base could not accommodate the flood of immigrants. "Poverty and epidemic followed unemployment. . . . Marauding bands of vagrants, many of them youths, terrorized the city with waves of theft and arson."

When not painting the things that angered him, Blythe wrote poetry about them. Witness a few lines about juries:

> Just imagine twelve ignoramuses
> With flat heads and red "wammuses"
> Sitting in judgment on an intricate
> Case of law. Beautiful, isn't it?

"Blythe's greatest wrath was reserved for politicians," writes Chambers. "By the mid-1850s, the artist's political allegiances had moved from the Whigs to the Know-Nothings, a party whose virulent anti-Catholic and anti-immigrant stance was happily short-lived. Blythe's attachment to their cause and candidate, Millard Fillmore, was based not so much on any natural antipathy to the immigrant but rather on what he felt was the immigrant's vulnerability to political manipulation by unprincipled opportunists (for the same reason he opposed enfranchisement of the blacks). . . .

"By 1860, Blythe's sympathies had turned to the Republicans and to their candidate Abraham Lincoln, the only politician for whom Blythe ever showed any respect."

His paintings went political: *Abraham Lincoln, Railsplitter,* a pioneer view of the man, surrounded by vignettes of his background and of the antics of his rivals. Then *Lincoln Crushing the Dragon of Rebellion,* with the President being held back from his task by a terrible dwarf sucking on an Irish clay pipe—a brutal cartoon of Irish-dominated Tammany Hall (which did not support the war and thus tacitly abetted the New York draft riots of 1863).

Lincoln's assassination, in April 1865,

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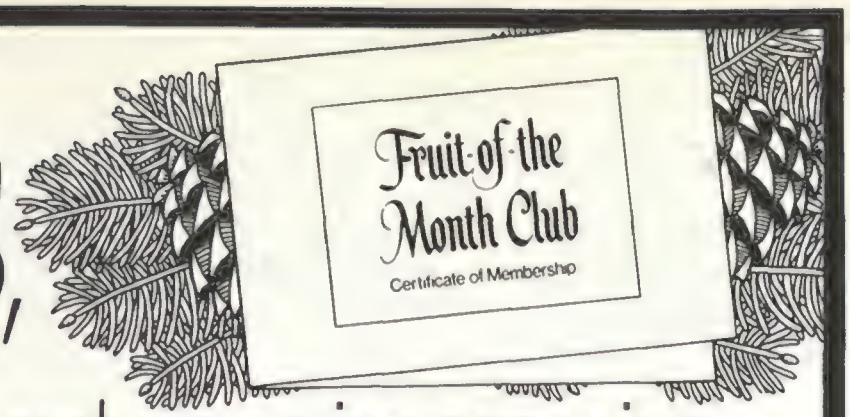

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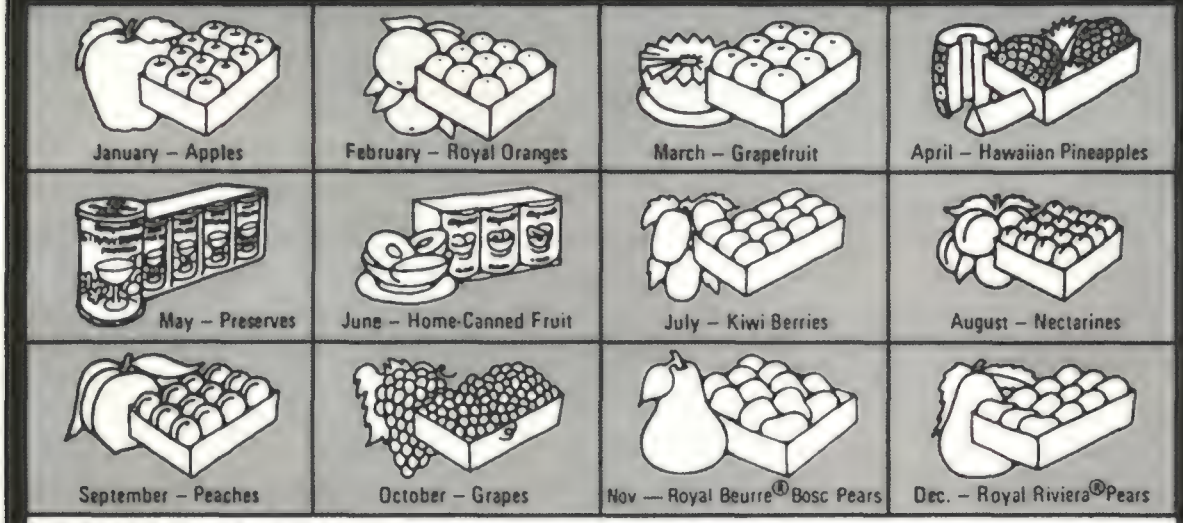

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was the last straw for the wrathfully moralistic Blythe. As Chambers notes, "the cornucopia of his sardonic wit included as targets the Irish, Germans and blacks as well as reporters, editors, clergy, judges, lawyers, politicians, other poets and rotgut whiskey." And in the end it was that last which brought him down. He died in an alcoholic stupor about a month after Lincoln was shot.

Blythe's work is powerful and moving and sobering—a reminder that mid-19th-century life was not all like *Little Women.* At the entrance to the display area is a photograph of the satirist: a tall, erect man with a beard; pleasant looking, strongly built. He doesn't at all fit your mental vision of the person who could paint *The Oatmeal Eater,* perhaps the most horrible of the Blythe urchins. Chambers says of this oafish child that it "stands out in starkest contrast to the prevailing climate of sentiment. The subject is a child of vegetal nature, neither witty nor charming, neither self-reliant nor hopeful. He sits there, the meal dripping dumbly from his bowl, a cipher without expression. . . . It is not the American dream."

The David Gilmour Blythe exhibit is on the third floor of the National Museum of American Art (hah! I got it right!) and it's worth the ascent. You've got all month to see it, and a bit of January. It is guaranteed to open a lot of new doors in your concept of our history. If you're depressed by the outcome of the election or the Superbowl, if you're gloomy about the environment and the energy drain and the general folly of our times, Blythe will give your misery some company, for obviously life wasn't so hot in his day, either. If Blythe becomes too much for you, then go back to dear, good Miss Louisa May Alcott.

Miss Alcott, by the way, possibly served as a nurse in a Washington landmark building—the Old Patent Office—which houses this newly named museum and the National Portrait Gallery. The building was turned into a hospital for soldiers during the Civil War. Miss Alcott left Concord, Massachusetts, to nurse the wounded, thus raising a lot of local eyebrows because the Florence Nightingale example was still pretty daring to follow —at least for *nice* girls.

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museums, and this time, leaving Blythe by way of the National Portrait Gallery, I was confronted by a smallish alcove devoted to a feisty 19th-century lady named Belva Ann Lockwood. She was a contemporary of Blythe, but 15 years younger and a couple of centuries more hopeful. So hopeful, in fact, that she ran for President in 1884, thus raising more eyebrows than Louisa did.

Think about that date—96 years ago. How many women have tried for the White House in all the enlightened years since then? And Mrs. Lockwood wasn't the first, either. Victoria Woodhull was nominated by the Equal Rights Party a dozen years before, as you will remember if you read our article in October 1977.

Gutsy Belva Lockwood ran against Grover Cleveland and got 4,149 votes, which was less than one percent of Cleveland's total. But at least she tried, and for almost a century no other woman really has. And I remember sitting in a tent in World War II chewing the fat with my squadron mates and agreeing that by about 1960 we'd probably elect a woman President. How unreal we were!

Belva appears in the Portrait Gallery, which retains its own name—and also its predilection for history. You might think she'd be equally comfortable at the National Museum of American History, which is the new name for the Museum of History and Technology. But thank God our Smithsonian seems to remain as open-ended and eclectic as ever—history mixed up with art, science and technology still blended with history.

And over at the Renwick, folk art is popping up beside displays of design. It's an exhibit from Oregon called "Webfoots and Bunchgrassers," words that reveal whether you're from wet western Oregon or dry eastern. Shown are items made by loggers and Indians, cowboys and farmers. Like all folk art, much of it is in useful things like furniture.

Sometimes, though, it's just for fun, like the bears below. They are part of a congregation of bears, listening to a preacher in the parklike yard of the logger-woodcarver who made them.

Woodcarver? The fact is that their creator, Wibb Ward, did these figures with a chain saw. These are about a yard tall, fashioned from driftwood. Wibb must use the round "toe" of his saw to do

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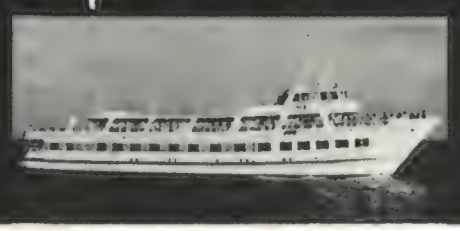

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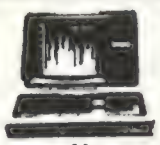

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his "carving." And he must be the noisiest sculptor in Oregon.

Thinking of bears and other animals, I joined an old friend for an autumnal look at the National Zoo. The new home for the great apes was due to be opened, but it wasn't yet. So we wandered over to look at our bears and allow them to look at us, which they did with dispassion.

Then we roamed the length of Beaver Valley. It was a splendid day, and the sea lions were playing like children on their wet rocks, the harp seals were doing laps in their pool, a white timber wolf, ears pricked up, watched us alertly, a beaver fluffed out its thick coat to dry in the sun and after much searching we found an otter blissfully asleep on its back beside the window that looks into its home. My friend, who appreciates life's good things, marveled at the little animal's soft, glistening fur, so fine and touchable on its underside, which rose and fell gently with its breathing.

Otter, beaver, wolf, seal, sea lion—a furrier's paradise, to be sure. "I hope," said my friend, "they don't change the name Beaver Valley to Fifth Avenue."

We both gazed a while at the otter, healthily oblivious to name changes, to politics, to social conditions, to art, even to the fact that this was a super day. Suddenly we both decided to get back to our respective desks and zonk out for the rest of the afternoon.

—EDWARDS PARK

Wibb Ward "carved" 15 driftwood bears using a chain saw. Here are two.

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By Otto Mayr

An offering of Renaissance clockwork masterpieces

Mythical gods, friendly beasts and heavenly objects all come together in 120 clocks and automata on exhibition from Germany

In A.D. 1601 Jesuit father Matteo Ricci, having struggled since 1583 to convert the Chinese to the Christian faith, at last gained entry to the Imperial Palace in Peking through a curious piece of luck. Among the gifts he had delivered to the Emperor were two mechanical clocks. Within hours officials from the court came running to him in great agitation: Why had the clocks stopped ticking and striking? Had they died? Ricci accompanied them to the palace and explained the functioning of these mysterious machines to the courtiers in charge of their care. Once he had their attention, he went on to describe the superior capabilities of Western science and technology. He implied that this superiority was the direct result of the Christian religion. He came away revered like a second Ptolemy. From that moment, mechanical clocks were prominent among the presents given by the Jesuits when approaching Chinese dignitaries. To maintain the China mission, the Jesuit fathers undertook periodic fund-raising trips to Europe. A report of such a trip in 1615-17 itemizes in detail the clocks contributed by various princely houses. Most of these clocks were made in Germany where during the years roughly between 1550 and 1650, clockmaking enjoyed a golden era.

Currently on display at the National Museum of American History (formerly called the National Museum of History and Technology) here at the Smithsonian Institution are some 120 examples of the finest clocks and automata surviving from the late Renaissance. These objects, on view through February 15, 1981, are on loan from 60 museums and private collections in Europe and the United States. Under the patronage of the International Council of Museums, this exhibition was organized jointly by the Museum of American History (aided by a grant from NCR Corporation) and the Bavarian National Museum in Munich, where the collection was shown this year.

German clocks were not only used to propagate the Christian faith, but were also important to the preservation of European peace. The Turks, in their drive to conquer Europe, came very close to taking the Imperial capital, Vienna, in 1529. Until the end of the 16th century, the weakened Empire was reduced to keeping the Turks at bay by regular payment of large tributes. Though they consisted largely of cash and jewels, clocks and automata made up a steadily increasing portion. As a voluminous diplomatic correspondence between Vienna and Constantinople indicates, most of these clocks came from Augsburg.

They were distributed among officials at the Sublime Porte according to their rank at court, with the most valuable pieces going to the Sultan himself. Often, the Turkish recipients detailed their wishes, even to the point of enclosing design sketches spelling out decorative schemes. To them, the timekeeping function was of secondary importance; often the more complex calendrical and astronomical indications were deleted. They coveted German clocks not only for their inherent curiosity but for the prestige of possessing an example of the most advanced technology of the age.

Though the clocks were valued by foreigners, the most enthusiastic audience was in Europe. The most outstanding pieces were collected by princes for their *Kunstkammern* (art cabinets). Rulers gave and received them as gifts of state, carried them home as war

Photographs by Erich Lessing

Kunsthistorisches Museum, Vienna

Centaur and Diana, made in Augsburg about 1600: entire assembly rolls on wheels powered by clockwork. While the centaur moves his eyes and shoots arrow, Diana and hounds turn their heads on the hour.

Private collection

To qualify as "master," journeyman David Buschmann made this typical masterpiece in Augsburg in 1652.

booty, or purchased them at high prices from Augsburg or Nuremberg masters. Some princes, such as the Emperors Charles V and Rudolf II, even employed eminent clockmakers for their own courts.

What was the basis of this wide appeal? It most certainly wasn't their simple utility in telling time. There is doubt whether accurate timekeeping was even a serious need in 16th- or 17th-century daily life. There is no doubt that these clocks, marvels of mechanical ingenuity that they were, were imprecise as well as temperamental. But, at the same time, they could do so much more. Their capabilities for sophisticated astronomical prediction, for intricate mechanical music and for automatic theater were so developed, and the decorations so profuse, that the hour dials are often difficult to find. Which of these charms dazzled contemporary audiences the most is now difficult to say. It is clear, in hindsight, that these Renaissance clocks and automata represented an achievement in mechanical technology unprecedented in history, and surpassed in popular impact only by the steam engine of the late 18th century.

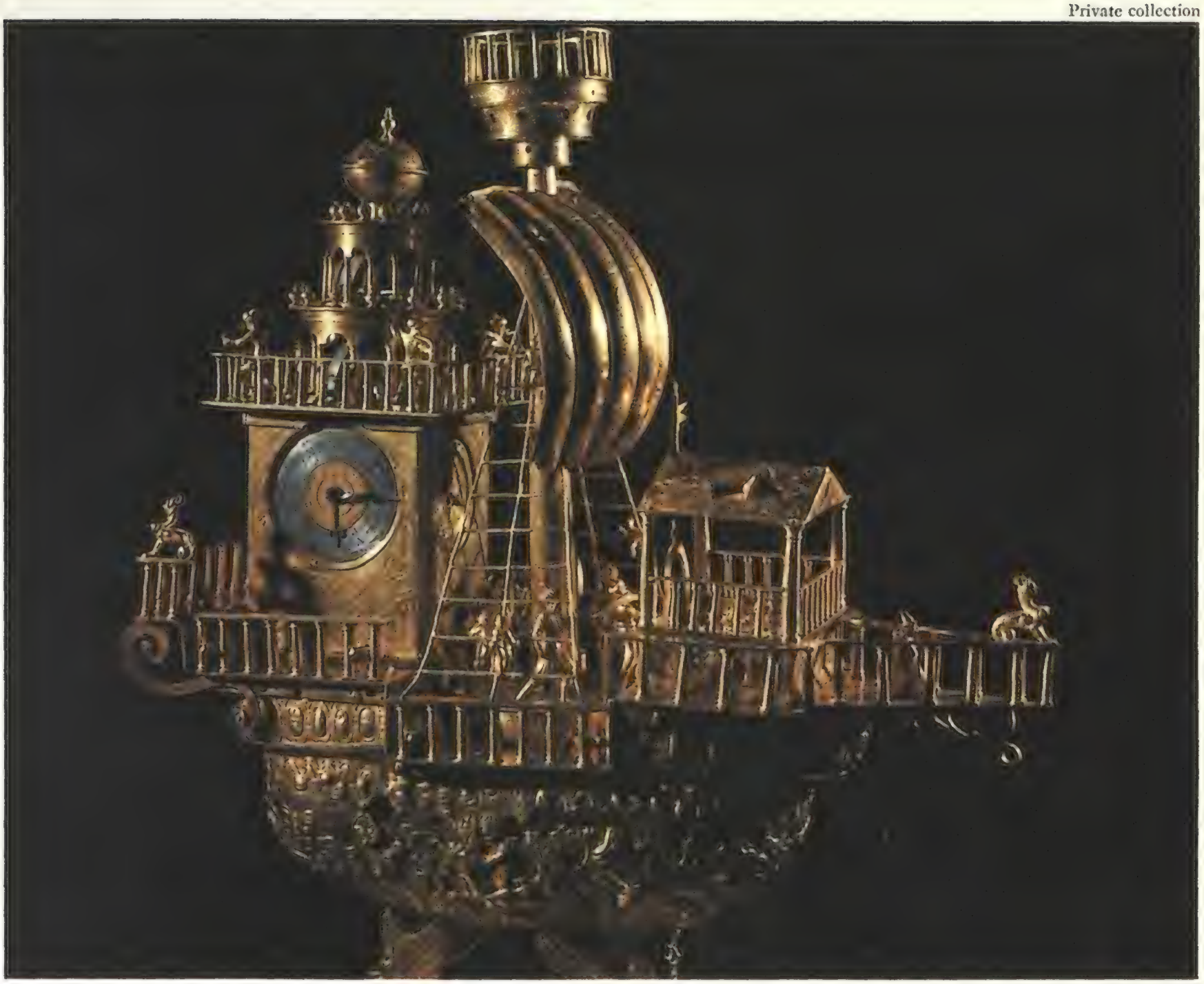
The mechanical clock was invented shortly before A.D. 1300 somewhere in Western Europe, where and by whom, nobody knows. The invention quickly spread. Within a century, every town of consequence had at least one large clock on its town hall or church tower that struck the hours and quarter-hours and, in some cases, was capable of a wide range of other performances. The engineering of clocks matured quickly. The repertory of the clock's mechanical design elements became large enough to make possible a wide range of capabilities and to permit the clockmaker virtually unlimited expression of his mechanical imagination. Few clocks made prior to 1550 have survived because so few existed.

The golden age of German clocks

By contrast, the years between 1550 and 1650 produced hundreds, perhaps thousands, of clocks and automata that are in today's museums and private collections. Most of them came from the German-speaking parts of central Europe that made up the Holy Roman Empire. Clockmaking flourished especially in south German towns like Nuremberg, Ulm, Strasbourg, Augsburg and Innsbruck. Outstanding among them was Augsburg which produced more than all the others. Clearly, that region had begun to produce clocks on a scale that almost deserves to be described as industrial. Why did it happen there?

The region had long had a reputation for metalworking skill. Also, raw materials were easily available and cheap, since Germany was Europe's acknowledged leader in metal mining. However, the real ex-

Private collection



Made in south Germany during the late 16th century, this clock in the form of a ship has indications of time and lunar age and phases. On the hour, a guard of Turkish soldiers marches around the mast.

planation of the phenomenon lies with the social structure. In the middle of the 16th century, independent clockmakers' guilds had established themselves in the more important German free imperial cities. These cities included Augsburg, Nuremberg and Strasbourg and were city republics. They stood, in loose and somewhat nominal subordination to the usually weak Emperor, independent of any intermediate overlords that tended to be far more exacting and powerful. The city republics governed themselves in democratic fashion. Most of them had acquired considerable wealth because of successful trade and expanding industry.

The craftsman's guilds, self-governing and self-policing cooperatives, were dedicated to the protection of the business interests of their members. They set standards of product quality, regulated and supervised professional training, controlled production and limited competition. Membership in the guild was reserved for "masters."

Only masters had the right to run independent workshops, to train apprentices and employ journeymen. The criteria for qualifying as a "master" were therefore crucial. These criteria were both technical and social. They frankly favored the insider. In Augsburg, for example, candidates whose fathers were already master clockmakers were admitted to start their masterpieces without restriction after a relatively brief journeyman's period of three (later four) years. Of all the out-of-town candidates only one was ad-

Author Otto Mayr, curator of mechanisms at the National Museum of American History, organized the clockwork exhibition and coedited catalog.

mitted per year, as selected by lot, and only after serving a much longer journeyman's period. He could get around the restriction, however, by engaging to marry the widow or daughter of an Augsburg master. Marriage was not allowed for journeymen, but was mandatory for masters.

After a candidate was admitted, he was assigned a specific type of clock as his masterpiece and given six months to complete it. In Augsburg, the regulation of 1577 required a masterpiece to be a clock about seven or eight inches high that was capable of the following functions: hour and quarter-hour striking; alarm; an astrolabe dial showing the position of the fixed stars in the zodiac; an automatic indicator for the length of day and night; a calendar dial; indications adjustable for 12- to 24-hour cycles (see p. 46). This clock had to take one of five standard forms, but in the design and execution of detail, the candidate was allowed a certain amount of freedom. In addition every candidate had to make a watch, shaped like an apple, to be worn around the neck. The regulation of 1577 remained in force unchanged until 1732. The similarity of surviving masterpieces, even if built a century apart, bespeaks the inherent conservatism of the guild system.

After a clockmaker became a master working independently in his own shop, his time was divided between repairing old and making new pieces. The bread and butter of the average clockmaker was the production of simple table clocks, capable of striking the hours and quarters, with an alarm, but little else unless especially ordered. A master and his journey-

To the accompaniment of drum rolls, the procession of Bacchus, mythical god of wine, proceeds every

Staatliche Kunstsammlungen, Kassel

The rectangular weight (top center) is pulled up once a day to drive this experimental clock by Jost Bürgi.

Städtische Kunstsammlungen, Augsburg

hour. The clock itself has many time and astronomic indications and was made in Nuremberg about 1580.

men could produce clocks of this type quickly and in great quantity, according to an unchanging standard plan. Many clocks were made on commission, with the customer specifying particular wishes which ranged from the most complex astronomical prediction to the most whimsical automata. Others could be purchased either off the shelf, at regional fairs or through agents.

Little is known of the skills and techniques of these master craftsmen. Although their training was broad and stressed versatility, their success depended most on an environment that offered every kind of support. The materials they worked with, sheet and bar stock of iron and brass, and wire of various sizes, were available from specialized suppliers. A wide range of clock parts, such as springs, bells, hands and pins, as well as cast bronze figures and other decorative elements, were manufactured by specialists and traded over long distances. Also clockmakers collaborated freely and creatively with members of other crafts such as goldsmiths, cabinetmakers and brass founders, to produce works that none of them could have accomplished alone.

As an apprentice, a clockmaker learned how to make his own tools. Unlike the finished work, most of the tools that were used were simple. The most important tool was the file. At times, however, they had to build special fixtures that would help facilitate the intricate work needed on complex pieces. The range of skills that a good clockmaker had to master was extraordinarily broad. It involved learning all the techniques of shaping the various metals to produce delicate parts fitting to extremely close tolerances. It also included a healthy measure of what we would now call engineering and science. The complex gear drives needed in astronomical clocks and lifelike automata had to be not only invented but also fitted into a very limited space in an orderly manner. This required high-level draftsmanship and competence in mathematics. This was particularly necessary if the task was to build mechanisms for complex astronomical indications (see p. 53).

Some clockmakers rose above the average, producing by commission from princes and noblemen works of great complexity and beauty. A few became famous and, like painters and poets, were befriended by kings. The Emperor Ferdinand III, for example, when in Augsburg, repeatedly called on the master clockmaker Johann Buschmann sr. "to converse with him on matters of the art." Imperial agents, on the other

Nationalmuseet, Copenhagen

Unusual table clock is driven by ball (left) falling on vertical path causing spiral-shaped cage to rotate.

Private collection

When hour tolls on the barrel, the seated Bacchus lifts his beaker, rolls his eyes and extends his tongue.

hand, compared their dealings with Buschmann to the handling of a shell-less egg. "He is obstinate, a man with a fearfully mean tongue and a hopeless drunkard, does not hold to agreed delivery dates, and frequently drives his customer to despair."

These agents had similar experiences with Hans Schlottheim, another star clockmaker from Augsburg. They urgently needed a particularly precious clock for the Sultan of Turkey. The master, they complained, was taking advantage of their predicament by holding out for an extravagant price. When a reduced price was at last agreed upon, Schlottheim missed the deadline. The clock arrived a year later. In another case, Imperial agents, who were trying to commission some automata from an unnamed Augsburg master, failed to obtain any completion at all. To finish this piece the master informed them, he could only work on bright, cloudless summer days which in Augsburg, needless to say, are rare.

One way of getting around negotiating with these intractable geniuses was to hire one's own. Several of the most gifted clockmakers found it advantageous to accept full-time employment in the princely courts. Here they found challenging assignments and the means to carry them out, freedom from the restrictive policies of the guilds, and the opportunity to exchange ideas with the leading intellects of the age. The prototype of these court-employed masters, and also the most brilliant clockmaker of the entire era, was Jost Bürgi (1552-1632), a Swiss from the Toggenburg valley. He worked for two of the most scientifically ambitious princes of the time, Landgrave Wilhelm IV (the "Wise") in Kassel and Emperor Rudolf II in Prague. Wilhelm IV was himself a practicing scientist who had succeeded in drawing the Danish astronomer Tycho Brahe to his court. Later Tycho was invited to the court of the Emperor in Prague. Jost Bürgi followed in 1603, where he was also associated with another, even greater astronomer, Johannes Kepler. Bürgi was once called by Landgrave Wilhelm a "second Archimedes," and by Kepler, the equal in his own field to what Albrecht Dürer was in painting. Bürgi was not only a clock- and instrument-maker but also a mathematician. He was a discoverer of logarithms and the inventor of a variant of the proportional compass, a kind of slide rule. His clocks and automatically driven celestial globes combined impeccable craftsmanship and the spare functionality of first-rate engineering with an inspired inventive imagination. The crossbeat escapement and the remontoir are also credited to Bürgi. Both of these mechanisms were designed to achieve higher accuracy, but were overshadowed by the revolutionary pendulum clock of Christiaan Huygens in 1657. This invention by the Dutch mathematician marks the end of the golden era of German clockmaking, and the beginning of a new and totally different attitude toward clocks and timekeeping. The pendulum permitted, for the first time, measuring time with high precision.

This invention was promptly taken up by Dutch, English and French clockmakers whose clocks were

Bayerisches Nationalmuseum, Munich

Standing two feet high, this complex lion clock by Hans Buschmann has many timekeeping capabilities.

Museum der Zeitmessung Beyer, Zurich

The eyes move continuously on griffin made by Johann Hallaicher in Augsburg about 1640.

scientific instruments with the single purpose of time measurement. These were accurate and reliable, simple and functional in appearance and often, quite literally, "black boxes."

At the same time, German clockmaking declined. After the Thirty Years War (1618-1648) the country was left impoverished, and its population decimated. The guilds, always suspicious of innovation and dedicated to no-growth, became more conservative than ever. They tried to carry on business as usual, although declining in quantity and quality. The princely courts, though proliferating in number, were reduced in significance and means by the extreme federalism of the Peace of Westphalia. They no longer provided initiatives, and nothing existed in Germany to match the central support of science and technology by the newly founded Academy of Sciences in Paris and the Royal Society of London. A period in the history of technology had ended and the Industrial Revolution was soon to begin.

One question still remains to be answered. What was the basis of the fascination commanded by the early mechanical clock, with its marginal utility on one hand, and its extravagant artistic endowment on the other? This is a difficult question for us to answer considering our conviction that functionality is the only justification of technological effort. Are we not inclined to dismiss the clocks and automata as frivolous playthings, relics of an era with confused values?

The mechanical clock was invented in an age when the passage of time was marked only by natural events such as the revolutions of the heavens and the life cycles of organisms. The new mechanism, running indefatigably with never-changing monotony, was greeted as a man-made counterpart to the regularity of the heavens. The harmony expressed in its running became the subject of poets such as Dante. The analogy between clock and world was employed by theologians to prove the existence of God: just as no clock could exist without a clockmaker, so the world necessarily must have its creator. This version of the "argument from design," was first invoked about 1400 by scholastic philosopher and French bishop Nicole Oresme, and remained persuasive in Europe into the 18th century.

It was thought that human life took place within three complex systems: the universe, the state and the body. Before long all three were compared to clock-

"The Clockwork Universe"

Metropolitan Museum of Art, New York

Mechanism in this piece built for Emperor Rudolf II indicates sun's progress as it appears to travel heavens.

work. The notion that the living body was like a clock arose from the experience with automata. Numerous legends were circulated in the Middle Ages of fabulously gifted mechanical inventors, from antiquity as well as recent times, who had succeeded in creating living creatures by means of mechanisms. Clockmakers set out to repeat, or at least approximate this miracle by building clockwork-driven figures of humans or animals that could move in many ways. The automata and figure clocks thus created were enthusiastically received by the public. Serious philosophers, notably René Descartes, at last took up the implied suggestion, and proposed a theory that the animal body functioned like, or indeed *was*, an automaton.

In the 17th century, Continental writers and poets had grown accustomed to comparing the role of the king in the state to that of the tower clock in the city, or to that of the escapement (or spring, or weight) within the clockwork. The king was the central element, the only source of intelligence and decisions, upon which all action depended. The rigidly authoritarian command structure implied in this view was thoroughly congenial to the political system of absolute monarchy that was sweeping through the Continent in the 17th and 18th centuries. One of its most outstanding exponents, King Frederic II (the Great) of Prussia, indeed regarded the state as clockwork. *"As all the springs of a watch conspire to achieve* a common purpose, namely that of measuring time, so the springs of government should be regulated, that all the different branches of the administration may likewise work together for the greatest good of the state."

If the people of the 15th to the 18th centuries liked to compare the three systems within which they spent their lives—the universe, the state and the body—to clockwork, then perhaps this tells us something about the enormous popularity of the mechanical clock in that period. The clock represented something that the reality of those centuries did not offer: an ideal order, a harmonious, centrally regulated, predictable and eternally reliable manner of functioning, that could be observed only in the heavens, and was only imperfectly realized in the living body, and sadly lacking in the political life of the times. At first, the mechanical clock expressed and exemplified this aspiration. At last, it provided the imagery and the conceptual vocabulary with which to articulate this conception of order.

Clock runs gearbox at bottom right of globe, which then drives the sun and the moon on the sphere.

Rosenborg Castle, Copenhagen

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Up with dawn before skiers hit the slopes, patroller at Snowbird, Utah, throws hand charge into unstable

hillside snow. Triggering slides with explosives helps prevent larger or untimely avalanches.

Text and photographs by James Balog

Second-guessing Mother Nature in the high snows

Using howitzers, hand charges and science, avalanche hunters try to reduce hazards of major slides in populous mountain areas

The snows of Little Cottonwood Canyon, Utah, are a force, a presence, in much the same way as are the fogs of London, the winds of Chicago, the cold of the Antarctic. During winter storms the peaks towering 3,000 vertical feet above the ski town of Alta and the nearby resort area of Snowbird sometimes receive knee- to waist-deep snowfalls for days on end. As a result, this part of the Wasatch Range, 25 miles southeast of Salt Lake City, is strafed by more avalanches than is any other populated area on the continent.

If the canyon is, then, an excellent place for learning about avalanches and their dynamics, it is the best place in North America for learning about how the avalanche threat is controlled. In fact, during the mid-1940s a U.S. Forest Service (USFS) snow ranger at Alta named Montgomery Atwater developed many of the avalanche-control techniques that have since become standard practice in this country. It had long been clear to avalanche workers in both Europe and the United States that the detonation of explosives placed within the snowpack could trigger avalanches. In fact, during the winter campaigns of World War I, one commonly used tactic was firing artillery into slopes deep with snow so that the resulting avalanche would wipe out the enemy. At least 40,000 Austrian and Italian troops are believed to have died in the Tyrol between 1915 and 1918 as a result of avalanches, many caused by such methods; 3,000 Austrians were killed during one 48-hour period alone.

In peacetime, avalanche workers in both the United

States and abroad realized that the potential destructiveness of a given slide path could be substantially reduced if explosives were used to trigger a series of relatively small slides before one large mass of snow built up. After World War II, Monty Atwater honed these techniques to a much finer degree of precision than had been attained previously. And today, avalanche-control workers even throw explosive hand charges into slide paths as they fly over in helicopters. Their work has developed a far more scientific basis than it had in Atwater's day, but it is still art as well as science. And, as the action during the winter of 1979-80 demonstrated, it is still fraught with the uncertainties of any art.

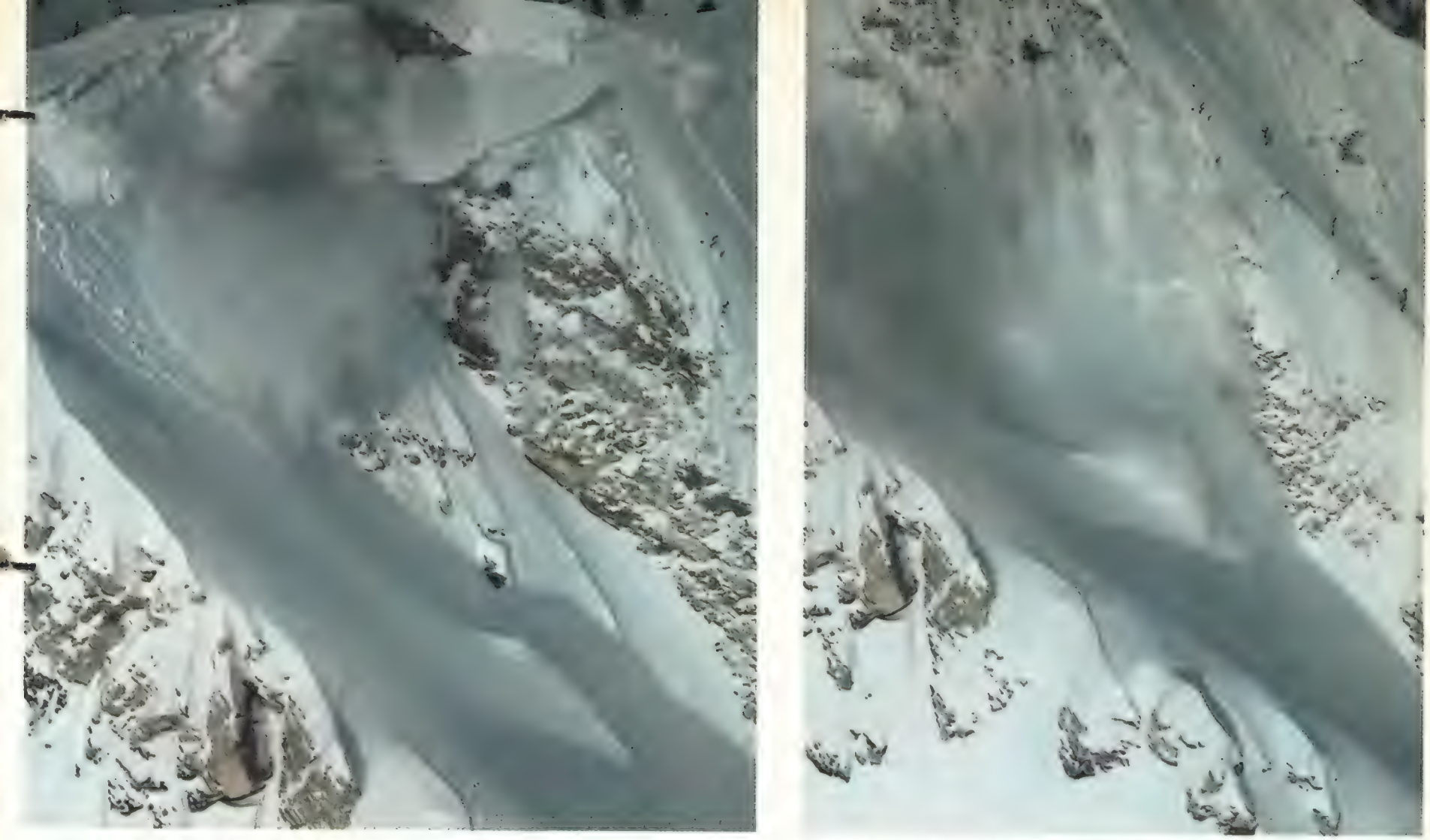
Imagine, then, a winter's night. The hours are the darkest ones, just before daybreak. Snow shoots in mesmerizing bullet streaks through the headlights. At first, the snowbanks along the narrow, winding road are only knee-deep. Gradually they build, and when they are deeper than the car is high, the signs begin: "Tanners Slide Area—No stopping or standing Nov. 1 to May 15"; "Little Pine Slide Area—No stopping . . ."

A light appears, veiled as if seen through gauze. The car parks in front of a concrete and glass building at the center of Snowbird. Footsteps click through quiet hallways; the sole office where lights shine is that of snow safety. Here are made the avalanche-hazard evaluations—and the decisions about how to deal with that hazard—that directly affect the safety of the thousands who ski and sleep at Snowbird each day.

Inside the office, five figures are clad in red parkas, wool caps and ski boots: Liam Fitzgerald, director of

Avalanche control in action: cornice (overhanging mass of snow) along ridge crest near Alta poses a

By the time the avalanche (begun above) has slid 1,000 vertical feet, a large mass of snow is involved.



hazard (left). Hurled from helicopter, a hand charge explodes, fracturing snow and sending down boxcar-size chunk weighing several tons (center). Shock of fall starts snow moving down slope (right).

In pit dug at fracture line of avalanche, scientist Rod Newcomb studies dye-sprayed layers of snow.

snow safety, his assistant Randy Trover, and three members of the ski patrol. Most have a slightly grizzled look, and resemble mountaineers more than brightly colored ski-area people. Their faces are grim.

On few mornings this winter has the snowpack been so unstable and Snowbird so threatened by avalanches. Because snow exists so close to its melting point, it is an exceedingly fickle substance. And, mechanically, it can behave one minute as a viscoelastic substance, the next as a brittle solid, and then as a fluid. Avalanche forecasting is therefore an awesomely complex business. Good forecasters study the snowpack from the day of the autumn's first snowfall. Since snow is least cohesive and most unstable during a storm or the 24 hours immediately following it, most forecasting efforts are directed toward watching the progression of a given storm. Observers monitor the type of crystals that are falling (pelletlike snow called graupel, for example, is less cohesive and stable than classic stellar crystals), the density or water content, how much is coming down and how fast it is falling, the settlement rate of the new snow, the air temperature, and the wind speed and direction. In addition, they must consider the depth of the old snowpack and the condition of its surface (an icy crust is a far better avalanche sliding board than is soft powder).

The worst kind of snowstorm

During the past ten hours, a foot of new snow has fallen and the winds have averaged more than 30 miles per hour. When snowfall is slow, the new snow crystals have time to form bonds both with the prestorm snow surface and with each other. But when it falls as fast as it did last night, the crystalline bonds do not have a chance to form before a deep mass of snow has accumulated. And when high winds redeposit snow, accumulations called windslabs are formed, which are especially prone to avalanching. Compounding today's problem, the storm began with cold temperatures, dropping light, feathery crystals, then warmed up to produce relatively wet and heavy flakes: the result is that the new snow layer is unstable in much the same way that a stack of loose papers overlain by a thick dictionary is unstable.

The radio crackles with a call from the highway department saying that the mouth of the canyon has been roadblocked. A phone caller reports that at Alta, a mile up the canyon, Onno Wieringa's shooting crew on Peruvian Ridge will begin firing their howitzer at 6:30. More phone calls indicate that maximum security is now in effect: everyone except avalanche workers (and a visiting journalist) is locked inside his or her hotel; doors and windows on the uphill sides of threatened buildings are shuttered. (Not that such measures

can offer absolute protection against large slides: winds of tornado speed can be generated in front of moving snow and avalanches have been known to push passenger trains off their tracks. But staying indoors is nevertheless much safer than wandering around outside.)

The snow-safety office has the air of a beleaguered fort soon to be attacked by an overwhelming enemy force. Indeed, days of such intense hazard are known in the canyon as snow sieges.

The war begins. The Alta gun, a surplus 75-mm howitzer from World War II, takes its first shot. It booms, and the air above the canyon instantly rips with a sound like tearing paper. The canyon thunders again as the shell hits a slide path known as East Hellgate. Several shots later, the Snowbird guns start in.

At 11,000 feet on the summit of Snowbird's Hidden Peak, the world is an inferno of wind and fog and blowing snow. The boom of the artillery is faintly audible. A tramcar rises up out of the clouds and a dozen ski patrollers, both men and women, step out. After they wait briefly in a small building, a radio call comes in: "Hidden Peak, Hidden Peak, this is the ridge gun. We've finished firing and you're clear to start people out on their routes."

Within minutes, patches of red whisk down the mountain. Inside each patroller's jacket are a half-dozen hand charges, heavy white cardboard cylinders full of a TNT-based explosive called pentolite (p. 63). Though such a charge has yet to detonate on impact in the nearly two decades it has been used for American avalanche control, no one loaded with pentolite skis with abandon.

Skiers look for trouble

Peter Schory and Jean-Jean Petitjean head for the start of a hand-charge route called Gad Valley number seven. They will traverse along the top of broken cliff bands and across a series of steep chutes. As they ski, they will throw hand charges ahead of and below themselves to clear any avalanches.

They will look for pockets of weak or overstressed snow. As the snowpack sits on a mountainside, it creeps imperceptibly downhill, gradually flowing like molasses and stretching like a rubber band (snow is thus said to be a viscoelastic substance). Eventually, this creep has a settling and stabilizing effect on the pack. But not all snow types are able to deform at the same rate; in many cases, these variations result from different temperatures within the pack. Thus, if strata with different capacities to deform lie next to each other, tension will build at the contact between them. This contact can be likened to a nick in a rubber band; eventually, the band will break at the nick.

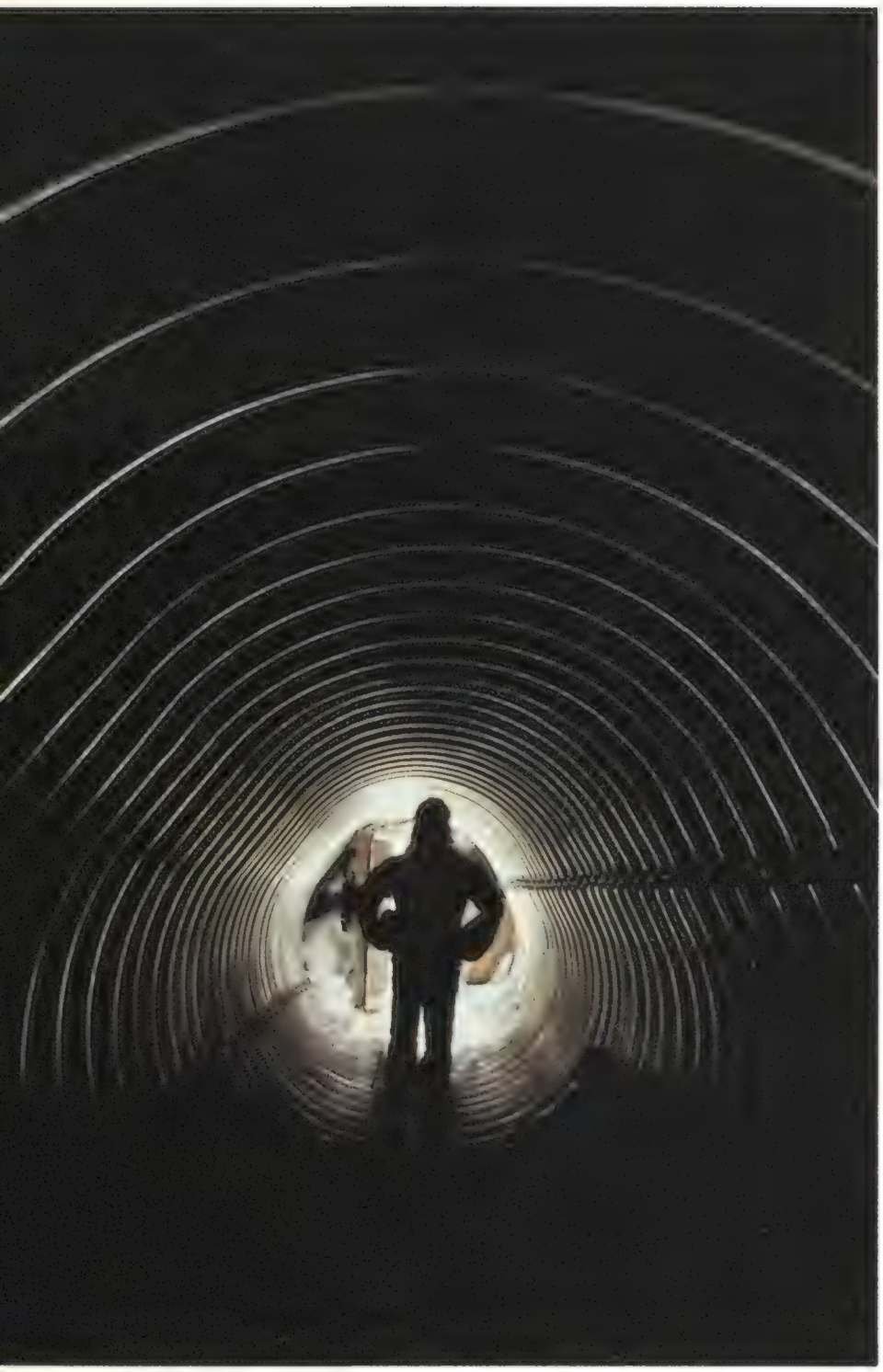
Liam Fitzgerald examines snow crystals taken from avalanche fracture line to determine type and size.

When more stress is added to an already tense snowpack, whether it's the weight of a skier, a new snowfall, a clump of snow falling from a tree branch or the shock of an explosive, an avalanche is the result.

Snow-safety workers like Peter and Jean-Jean know from experience where each unstable pocket of snow is likely to lurk. It may be a shaded spot in the lee of a gully wall. It may be a virtually invisible snowdrift in the middle of a smooth slope. Or the danger might be more felt than seen. As Liam Fitzgerald puts it: "There's a physical connection between me and that snowpack. When there's tension in it and I'm skiing, I swear I can feel the electricity running up through my legs—and other guys who have been around avalanches a long time say they feel the same thing. Most people don't like to pay attention to feelings like that because we think we're so sophisticated, but those things are *real.*"

As Peter and Jean-Jean ski slowly down their route,

A photographer and writer who specializes in Earth science and environmental stories, the author spent a month at Snowbird's slopes last winter.



High above Snowbird on Hidden Peak, underground steel-and-concrete-lined bunker stores ammunition.

Snowbird ski patroller Nan Rogers assembles rockets to be launched by a compressed-gas gun.

they squint into the storm, watching how the snow reacts under their skis, studying the snowflakes, and sniffing the air almost like English setters. Hand charges or "shots" are thrown only from islands of safety such as thick groves of trees.

"The snow is really sensitive," Peter radios back to the Hidden Peak dispatcher. Every shot triggers slides that tumble, eerily silent, into the fog. The slides are large enough (approximately two feet deep by up to 50 feet wide) that an unwitting skier would be swept away and perhaps killed, but they are of routine dimension to avalanche workers. Though the work is slow and somewhat tense, it is not, then, particularly frightening. Until . . .

Until Peter begins ski checking (testing the stability of the snow by skiing on it) along a cliff band and gets a little too low. The slope fractures knee-deep and blocks of snow flow down onto him.

The best avalanche-survival technique is to use swimming motions to remain on top of the snow and avoid burial. But Peter is dragged deeper into the slide. Momentum builds. The avalanche is nearly up to his waist. He shoots 10, then 20, then 30 feet down the mountain—with a long, long way to go before hitting the bottom. As he plummets past a small tree, he manages to grab it and hold on against the force of rushing snow. Finally, the avalanche passes. He is left with a tree in his arms and a haunted look in his eyes. Later that morning, the head of the ski patrol

Weird innards under parka are hand charges, carried this way by Snowbird ski patroller for easy access.

will greet him, "Hey, Peter, I hear you had a religious experience."

Others have been less fortunate in their encounters with avalanches. People buried only a foot deep are usually immobilized and if, as often happens, the slide forces snow into the victim's nose and mouth, death by suffocation may be 10 to 15 minutes away. If a victim can somehow make an airspace around his or her head before the snow stops moving, the chance of surviving a 30-minute burial is 50 percent. Some one-third of the victims survive an hour-long burial—but almost none lasts longer than six hours.

Approximately three-quarters of all U.S. avalanche victims are, not surprisingly, participating in mountain sports, particularly skiing and climbing, at the time of their accidents. The remaining one-fourth are motorists and people who live and work in the mountains. During the first half of the 1970s, 12 people were killed each winter, on the average—a rate double that for the preceding 25 years.

But the United States' difficulties with avalanches pale in comparison with those of other countries. In Europe, avalanches have been wreaking havoc for millennia. They are thought to have played an important part in decimating Hannibal's army during its epic crossing of the Alps in 218 B.C. Napoleon's army was likewise plagued in the Great St. Bernard Pass on its way to the Battle of Marengo in 1800. And the beginning months of 1689, 1720, 1889 and 1951 are notorious in Alpine history for avalanche destruction. In 1720, at Obergesteln in Switzerland's Rhône valley, an avalanche from a slide track called the Galen killed 88 people. But, in recent times, the winter of 1950-51 was the worst: 279 people died.

Though the United States is not likely to sustain such a tremendous loss in the foreseeable future, the accident rate will continue to increase. The reason can be read between the lines of the "me movement." Knox Williams, a USFS avalanche forecaster based in Fort Collins, Colorado, writes: "With the desire to get away from the crowd (and the rising expenses of lift skiing), many winter sports enthusiasts are now crossing steep slopes that had not before seen a climber, skier or snowmobiler. With more people taking risks, the number of avalanche victims can only increase." Bengt Sandahl, the USFS ranger who oversees avalanche-control work in Little Cottonwood Canyon, adds: "Today, skiers press very hard to get just two turns in untracked powder. Everyone is out there looking for the heavenly powder experience he's heard so much about. But even within a ski area, there's no way to completely control *all* the unstable snow."

Compounding the problem is the scarcity of mountain real estate suitable for development; those who would build homes have been building and will continue, in increasing numbers, to build in unsafe areas. In many cases, development proceeds unrestricted. The result has been accidents like the one at Stevens Pass, Washington, where, in January 1971, a slide hit seven cabins and four of the 13 people who were buried were killed.

Complete protection is not possible

At Snowbird and Alta, avalanches periodically hit hotels and automobiles and occasionally injure or kill people out on the slopes—but the potential for a truly major accident is great. Says one well-informed Snowbird official: "The hazard here is very acute. There are just too many people and too many buildings in avalanche tracks. We figure that the snow-safety people can just shoot the slide paths a lot and that we'll then be safe. But that simply isn't realistic. Avalanche science is not at all precise and there are *lots* of surprises."

Field specialists like Liam Fitzgerald and Onno Wieringa, working closely with the USFS, are able to predict about 70 percent of the slides that run in their areas of responsibility. But there is, of course, that other 30 percent. The slides in that fraction which, more than anything else cause forecasters to lose sleep, are called post-control releases. They occur after—sometimes nearly a day after—a slope has been blasted

Toledo Basin slide at Alta last February played jacks with 14 cars in lodge parking lot.

with artillery or a hand charge. They are the slides that wait until dozens of people have skied a slope before they release—and, as a result, they are the slides against which there is no protection.

Dr. Edward LaChapelle, described by a colleague as standing "head and shoulders above the rest of us in his understanding of avalanches," has this to say: "We might be able to get our forecasting success rate up into the 95 percent range someday, but whether we could ever get the last few percent is questionable."

A few days after Peter Schory's encounter with the avalanche at Snowbird, 20 inches of snow, accompanied by high winds, fell overnight. By morning, maximum security was in effect and the artillery boomed once more. Fog hung low in the canyon, but visibility was adequate for seeing clouds of avalanching snow flowing down perilously close to the villages.

Above Alta is a large bowl called Toledo Basin. Like many other local slide paths, it produced substantially fewer avalanches during centuries past, when a forest of spruce and fir trees helped hold the snow in place. But in the mid-1800s miners denuded the slopes and now, when a winter's snowfall exceeds the depth of the tree stumps remaining, the unbroken snow surface is an ideal sliding board.

When shot number 60 from the Alta howitzer hit Toledo Basin, an avalanche 300 feet wide and four-and-a-half feet deep broke out. By the time it had flowed 2,000 vertical feet, a mixture of snow blocks and powder snow was sailing along at 100 miles per hour. It ripped into the parking lot of a hotel: 14 cars were tossed around like trinkets (left) and one of them, a small pickup truck, was rammed through the wall of a room on the structure's second story. Some windows were broken and three rooms were partially filled with snow. But because the maximum-security procedures call for evacuation of that portion of the building which was hit, no one was injured.

Was the accident a failure of the avalanche-control program? Says Wieringa: "Not really. The weather forecast was bad: they were forecasting six inches of snow and in a few hours we had 20. Suddenly, we were way behind on bringing them down and wound up with a slide much larger than any we want to have."

So it was bad luck, then? No, he maintains: "I hate to use the idea of bad luck in connection with avalanches. Nobody in control work thinks that we can really control avalanches completely—and anyone who thinks he can is misguided. It's not 'bad luck' that nature gained the upper hand: it's just the way it is."

Caught in motion, projectile rips out of 75-mm recoilless rifle toward target on snow-laden slope.

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By Richard Hornik

In the days when the arts were a part of the Revolution

Collection van Laack Company

Clear and bold as a semaphore signal, this costume, re-created in 1979 by the van Laack Company of West Germany, was designed in 1922 by Lyubov Popova for production of *The Magnificent Cuckold.*

From 1910 to 1930 the Russian avant-garde experimented wildly with painting, design and theater in a movement recently rediscovered

Casts of thousands, including contingents of soldiers, presented massive street spectacles reenacting events of the Revolution. This is a performance in Petrograd as seen in 1919.

A mob of Russians 10,000 strong rushed toward the Czar's Winter Palace in Petrograd waving guns and sticks above their heads. But this time they were cheered on by government officials before an audience of 100,000 citizens. The swarming masses were participants in a 1920 "mass spectacle" reenactment of the real event that took place in 1917. Leading painters, poets and other artists helped plan and direct such events often in the years just after the Bolshevik Revolution, as the government used the arts to advance its cause in ways undreamed of by any ruling body before it. As the People's Commissar of Education, Anatol Lunacharsky, said at the time, "If the Revolution can give art its soul, then art can endow the Revolution with speech."

Just as the period surrounding the 1917 Revolution was a time of great social and political upheaval, a similar unrest was evident in the Russian world of art. And this confluence helped to create what is sometimes called the Russian Renaissance. During this era, covering the first quarter of the 20th century, new ground was broken in poetry, music, graphic design and, most important, in painting and sculpture by artists loosely connected by the classification "avant-garde." While some of the products of this period are well known in the West—the music of Igor Stravinsky and the paintings of Marc Chagall and Wassily Kandinsky—many of its contributions have long been denied their rightful place in the cultural history of the Western world.

Part of the blame for this oversight rests with the Soviet government, which officially considers the

Collection of Robert L. B. Tobin

Natalia Goncharova's collage, *Espagnole*, 1916, shows influence of Western avant-garde art of the time.

Artists Goncharova and Larionov acted in 1914 film, *Drama in Cabaret No. 13*, a satire on society.

avant-garde period never to have existed—in Soviet history books there are noneras as well as nonpersons. There is considerable irony in this denial, since many of these artists actively participated in the earliest attempts of the Bolsheviks to transform society. But with Stalin's full accession to power in the late 1920s, he formally dissolved that partnership, and the "bourgeois" and "decadent" efforts of the artists who considered themselves social engineers were condemned to the basement storage rooms of Soviet museums, never to be seen in the Soviet Union and only rarely to be sent abroad. On those few occasions when the Soviet government did consent to lend some examples from this period, it did so with strict conditions.

Such censorship has undoubtedly worked to delay a full and scholarly examination of the avant-garde period, but could not stop it. The Los Angeles County Museum of Art unveiled in July an ambitious exhibition of this important era: "The Avant-Garde in Russia, 1910-1930: New Perspectives." While not as large as last year's "Paris-Moscow" exhibition at the Georges Pompidou Center in Paris, the Los Angeles show, which moved to the Hirshhorn Museum in Washington in November, where it will be on view through February 15, presents a representative selection of works from the period. And the Los Angeles County Museum's modern art curators Maurice Tuchman and Stephanie Barron accomplished this feat without the benefit of any Soviet contributions. They scoured European and American art collections for four years, eventually securing loans from 107 lenders.

Western influence on Russian art

In some ways it is surprising that an avant-garde movement in the arts, of truly European proportions, developed at all in early 20th-century Russia, then one of the poorest and most backward members of the European family. But Russia was by no means isolated from the artistic ferment extant in Western Europe. Russian art collectors, most notably Ivan Morozov and Sergei Shchukin, began in 1906 buying and bringing back to Russia the latest examples of the trailblazing works of artists like Picasso, Matisse and Maurice Denis. Russian artists, including Mikhail Larionov and his lifelong companion, Natalia Goncharova, were also traveling to the West to see firsthand the latest developments in the use of color (fauvism) and figures (cubism), both of which greatly affected the development of avant-garde artistic styles in Russia.

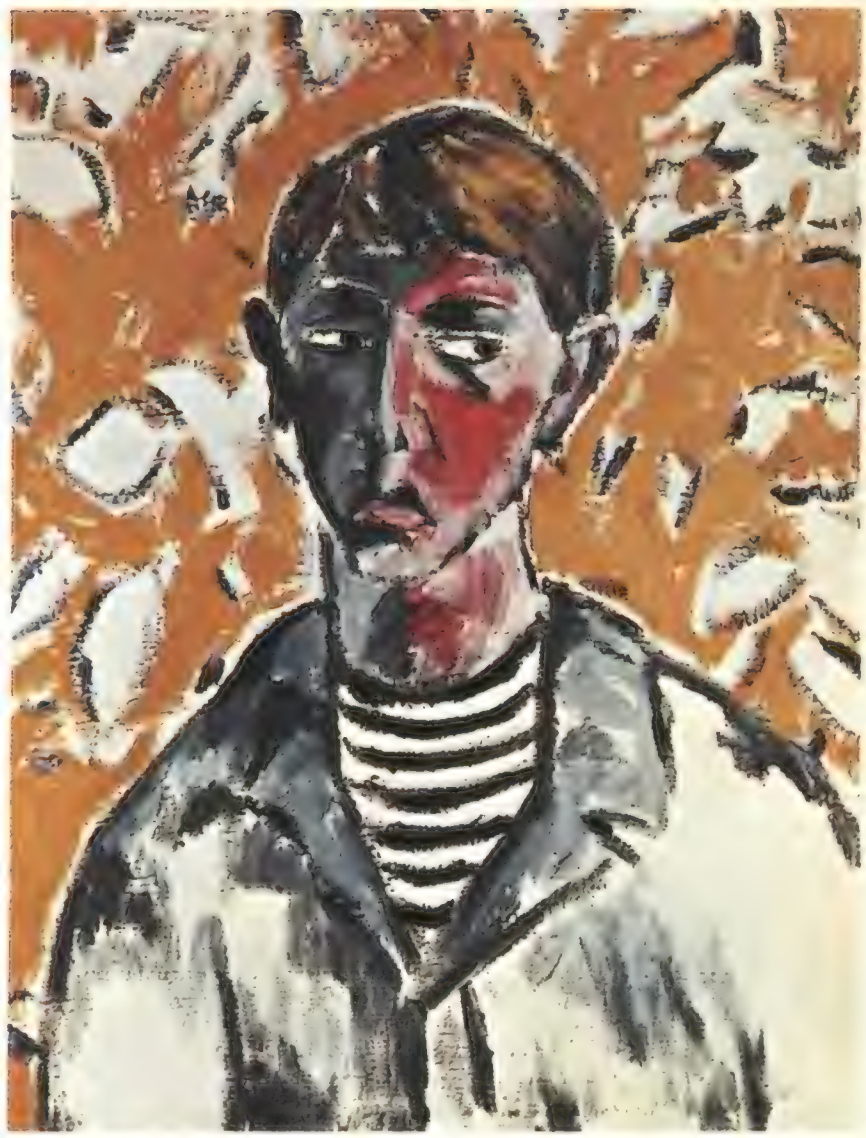
But the Russian avant-garde was hardly a mere adaptation of Western influences. The early 20th century in Russia was also a time of rediscovery of the country's own impressive artistic traditions. The rich

colors and powerful lines of medieval Russian icons strongly influenced the modern Russian artists.

These forces coalesced into the "neoprimitivist" movement led by Goncharova, Larionov and the Burliuk brothers, Vladimir and David. Larionov was one of the earliest leaders of the avant-garde movement. His formal training as a painter at the Moscow Institute of Painting, Sculpture and Architecture was enhanced by trips to Paris. Larionov and Goncharova left to settle permanently in Paris in 1914, but not before their neoprimitivist and later rayonist paintings left a significant impact on their contemporaries.

The highwater mark of this phase came at what was the first major, totally Russian avant-garde exhibition, "Donkey's Tail." Organized by Larionov and Goncharova in 1912, it also included works by the two Russian artists who eventually came to dominate the avant-garde movement until its demise: Vladimir Tatlin and Kasimir Malevich. The exhibition did not bode well for the artists—the general reaction was one of ridicule, and the Czarist government confiscated many of the works. But it did mark the coming of age of the Russian avant-garde as an independent group, no longer relying on the West for artistic inspiration.

Collection of Jay S. Cantor



In pre-Revolutionary days, Larionov painted fauvist *Portrait of Tatlin in a Seaman's Blouse*, 1908.

All art forms blend in "futurist" opera

In the next two years one last Russian variant on a Western art movement did appear briefly. Cubofuturism combined some of the elements of the primitive style with a heavy reliance on French cubism. But, more important, it was a style that involved a close relationship with other art forms, particularly poetry and music. This interaction was best illustrated in the futurist opera *Victory over the Sun*. Malevich collaborated with the poet Alexei Kruchenyk and painter-musician Mikhail Matiushin to produce a story praising Man's innate powers. Malevich's costumes and sets relied heavily on geometric shapes in black and white, a foreshadowing of what came to be known as suprematism. Just as abstract as the scenery and costumes were the plot, dialogue (sung by nonprofessionals), and the occasionally dissonant music played on a single out-of-tune piano accompanied by cannon shots and factory noises. It was all part of an effort, never very successful in commercial terms, to meld all art forms. As Kandinsky wrote in 1920, "Never before has such interest been shown by musicians toward painting, by painters toward architecture, by architects toward poetry. . . ."

The opera was also a reflection of the conscious effort of these artists to be as outrageous as possible. They took a certain delight in eliciting violent reactions from spectators at their exhibitions. And artists like the Burliuk brothers took their message to the streets as well, giving impromptu poetry recitals on street corners while dressed in bizarre outfits with designs painted on their faces (p. 76).

But the opera itself also serves as an example of one of the most influential currents in Russia at that time: Prometheanism. James Billington, director of the Smithsonian's Woodrow Wilson International Center for Scholars, defines it as "the belief that man —when fully aware of his true powers—is capable of totally transforming the world in which he lives." Russian intellectuals before and during World War I were obsessed with the question of how to change their backward, oppressed country. While it might appear that many of the artists of the time concentrated on rather theoretical questions of artistic form and technique, that did not mean that they were indifferent to social issues. Rather, they hoped society's ills could be solved through art.

A Washington correspondent for Time *magazine, the author has a graduate degree in Russian studies and has reported extensively on the Soviet Union.*

Suprematist artist Kasimir Malevich, center, is surrounded by students departing for Moscow in 1920.

The Museum of Modern Art, New York

Malevich's art, as exemplified by red and black squares, reduced work to nonobjective elements.

This was not a new theme in Russia. For hundreds of years the only acceptable form of painting was the icon, which was clearly intended to shape the spirit of the people. And even in the 19th century, after the secularization of Russian society, literary critics like Vissarion Belinsky were really social critics in disguise. It was the social content of literature that concerned them and not the words themselves. To this day, Russian writers like Alexander Solzhenitsyn view their works more as social commentaries than as pure literature. Thus "art for art's sake" has never held much sway in Russia. And in the second decade of the 20th century, with the very foundations of czarism beginning to crumble under the weight of its own unenlightened superstructure, it is little wonder that these futurists believed in the inevitability of a political

Los Angeles County Museum of Art

A 1980 reconstruction of a monument conceived by Tatlin, never realized except as a model.

revolution that would change the shape of the country. At the same time, they believed that the shape of art would also change.

One indication of the transformation these artists had in mind can be seen in the important role played by women in the avant-garde. Perhaps no other artistic era benefited as much from the contribution of female artists as did the Russian avant-garde. Along with Goncharova, who was as important in the neoprimitivist movement as was her companion Larionov, such painters as Lyubov Popova and Alexandra Exter participated in bringing to Russia the latest innovations from Western Europe and in taking those influences and giving them a truly Russian character.

But there was no conscious effort to remold society through direct means. The goal of the artists of this period was to change society by reaching down into the spirit of the populace. During the search for such art forms, in the midst of World War I, two separate but complementary movements emerged: the suprematism of Malevich and the constructivism of Vladimir Tatlin. Tatlin (1885-1953) ran away to sea at the age of 18 to escape an unhappy home life. Upon his return in 1904, he renewed an earlier friendship with Larionov, whose love of icons and folk art greatly influenced his protégé. But Tatlin's time in the merchant marine also played an important part in his artistic development, as he had amassed considerable manual skill and a great knowledge of various materials. Following a visit to Picasso's Paris studio in 1913, he began to experiment with constructions of wood and metal called *Counter-Reliefs*. The materials were presented in natural forms and colors and in three-dimensions. Tatlin's basic thrust was to create constructions in which the materials conformed to natural laws and thus would have an almost subconscious appeal to the masses. He also mounted some reliefs in the corner of a room, similar to the presentation of icons in many Russian homes, as though he were striving for the creation of secular icons.

A self-contained harmony of forms and colors

Malevich (1878-1935) was also concerned with color, shape and textures, but his suprematism was a form for paint and brush, rather than the natural materials favored by Tatlin. First influenced by neoprimitivism and then cubism, Malevich left those styles behind in 1915 in a dramatic artistic departure. In his book *Artists in Revolution,* Robert C. Williams describes the rivalry between the two artists, which surfaced at a show including the debut of Malevich's vivid, abstract figures. "He hung a sign outside his exhibition room proclaiming 'suprematist painters.' Tatlin responded with a sign at the door of his room that read 'professional painters.' "

Whereas the cubism of Picasso and other abstract art was based on a partial representation of actual objects, Malevich went beyond that to nonobjective painting that represented "nothing" but rather strove for a totally self-contained harmony of forms and colors. This was again an attempt to reach into the subconscious of the masses.

Initially, the "supreme" for Malevich was a black square on a white background—black as the absence of all colors and white the presence of all colors. Consumed with his creation, he was unable to eat or sleep for a week. In 1917-18 he went even further, experimenting with paintings consisting entirely of shades of white, his *Suprematism: White on White* (unfortunately not available for the Los Angeles show) being

From *Pro Eto*, Collection Australian National Gallery, Canberra

И снова
стен раскаленные степи
вод ухом звенят и вздыхают в тустепе.

Rodchenko used many media and applied art to design, as in this photomontage for a poetry book.

the most famous example. But having reached the "supreme" there was little left for Malevich to do with paint and brush, and in the 1920s he joined many of his contemporaries, led mainly by Tatlin, in producing utilitarian objects for the masses.

While in strictly artistic terms many of the most interesting and enduring avant-garde works appeared before the Bolshevik Revolution, the decade immediately following it was just as important historically. That era was characterized by the attempts of the avant-gardists to put theory into practice and transform Russia. Unlike the experiences of the futurists in Italy and the expressionists in Germany during the first third of this century, the budding totalitarian regime did not move quickly to stamp out these potentially dangerous nonconformists. In fact, artists like Kandinsky, Malevich and Tatlin were running state art schools or serving as local commissars of art.

One obvious explanation for this is that the Bolsheviks were far too busy consolidating their economic and political power to worry about the bizarre ideas of artists. And many of the artistic experiments while radical were also ineffectual. A prime example of that was the "Persimfans," an orchestra free to do its own thing without the unnecessary meddling of a conductor—but with very predictable results. There were also revolutionary idealists within the Bolshevik leadership like Anatol Lunacharsky, the first Commissar of Enlightenment (or Education, the word is the same in Russian). He believed that the proletariat would choose what was best for itself as a class. He was also convinced—as was Trotsky, to a degree—that art and science would flourish only in an environment free of government interference.

And the old Promethean strains continued to dominate in the years following the Revolution, along with an increase in the intermingling of the arts that had begun before 1917. One major example of this ferment was the emergence of the mass propaganda spectacles with casts of thousands (p. 69). Artists like Natan Altman not only designed costumes and decorations for streets and buildings, but also helped plan and direct these extravaganzas, which were intended to get the political and economic message of the government over to a largely illiterate people. Many of the spectacles commemorated major revolutionary events like the storming of the Winter Palace and the blockade of Russia by the Western powers. But they also treated ideological concepts such as the world proletariat revolution—"Toward a Worldwide Commune" was a favorite.

A symbol of the utopian world

Although this was an era of art with a purpose, it was not devoid of ambition and imagination. Tatlin in 1919 designed and built a model of his *Monument to the Third International* (p. 73). His plans called for a spiral framework of iron twice the height of the Empire State Building, containing a glass cylinder, cube, hemisphere and pyramid. The monument was to be functional as well, housing a public-information center, but it never got beyond the model stage. As Camilla Gray, perhaps the foremost authority on this period, wrote, "This model came to be a symbol of the Utopian world which these artists had hoped to build. In many ways it is typical of their hopes, so ambitious, so romantic and so utterly impractical." (The Los Angeles exhibit contains a small reconstructed model of the monument.)

But much of this art was utilitarian. Many members of the avant-garde—Malevich, El Lissitzky, Ilya Chashnik, Nikolai Suetin, Nadezhda Udaltsova—turned to industrial design in what was called the "productivist" school. That switch was even formal-

12 YEARS OLD WORLDWIDE • BLENDED SCOTCH WHISKY
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I'll be home for Chivas.

ized in an art exhibition of 1921, "5 × 5 = 25," in which five artists each presented five works. All of them used the show to denounce once and for all any allegiance to traditional art forms and gave their allegiance to industrial design for the masses.

In other areas of design the Russian avant-garde made major contributions. Lissitzky had been trained in Germany as an architect and engineer before the war, and he studied under Chagall and then Malevich in one of the state-run art schools following the Revolution. His "Prouns" (an acronym for "project for the affirmation of the new"), heavily influenced by both Malevich and Tatlin, were radical departures in which geometric shapes were used but in unusual spatial relationships. But Lissitzky is best known in the West as one of the leading book designers—for both his typographical design and his use of illustrations.

Likewise, Rodchenko, a trained artist whose works show the influence of Tatlin and Malevich, moved beyond the easel—he was one of the participants in the "5 × 5 = 25" exhibition—and became one of the leading developers of the photomontage technique. He applied photomontage to another area in which he was a trailblazer, poster art, and joined forces with the futurist poet Vladimir Mayakovsky to produce propaganda (and advertising) posters that still stand today as prototypes of effective poster art. In 1924 *Pravda*, praising the partnership's work, said, "the taste of the masses is formulated not only by, say, Pushkin, but also by every wallpaper design, by every candy wrapper design."

The members of the avant-garde who continued to produce and survive in Russia after Stalin consolidated his power in the late 1920s and enshrined "socialist realism" and art "comprehensible" to the masses were the ones like Rodchenko, Lissitzky and Tatlin, who contented themselves with the design of everyday objects. Others like Chagall, Kandinsky and Exter left within a few years of the Bolshevik takeover following disagreements with their contemporaries over the direction of art. Still others—Larionov and Goncharova—did not bother to find out what life in the new society would be like; they had moved to the West in 1914. Malevich died in Leningrad in 1935.

Even though this exhibition is the most comprehensive and analytical on this period thus far, curator Barron notes that there are still as many questions awaiting answers as there are answers. How this is going to be resolved for a period that officially doesn't exist is perhaps the largest question of all.

Painter David Burliuk decorated face and wore a spoon in his pocket.

Los Angeles County Museum of Art

A 1980 model of a 1933 project, *Architectural Fantasy #28,* by the architect-academician Yakov Chernikov.

Thyssen-Bornemisza Collection, Lugano, Switzerland

Artist/designer El Lissitzky conceived of the "Prouns" as "a changing-trains between painting and architecture," or a midpoint between two- and three-dimensional forms. Above is his *Proun 4B*.

I'LL FIGHT—
Lord
today that you and I
together

By Jack Fincher

An army salutes its hundred years war with Satan

A band of unblushing Salvation Army lassies who landed here a century ago launched a campaign that is now an $800 million crusade

In a 1917 appeal, the U.S. Commander, Eva Booth stood by familiar Salvation Army kettle all day long.

In his annual report of 1878, William Booth, founder of a ragtag Christian mission to the miserable dregs of Victorian London, wrote that his growing legions of zealous evangelists had become nothing less than a volunteer army. His eldest son, Bramwell, objected.

"Volunteer! I'm not a volunteer. I'm a regular or nothing." His father promptly scratched out the offending word and penned in "salvation." Bramwell's reaction, given the nature of what he had wrought, was eminently suitable: "Thank God for that."

Amen, brothers and sisters. For on this, the 100th anniversary of the Salvation Army in the United States, tens of thousands of American men and women, in claret-trimmed caps, coal-scuttle bonnets and military tunics of midnight blue, are still marching beneath its banner of blood and fire. Indeed, as it goes forth to battle the Devil for a second century, led by its 17th National Commander, Ernest W. Holz (opposite), the Army in America follows a Disposition of Forces that scarcely begins to suggest the nationwide richness and diversity of its continuing effort. In many cities, teen-age mothers are given counseling and special education during pregnancy, as well as nursery and day-care services when they return to school. Neglected children in Detroit and St. Louis can look to the Army for emergency shelter care; the retarded and disabled find homes and training, where feasible, at Army outposts from Royal Oak, Michigan, to Fort Worth and San Diego.

The current National Commander, Ernest W. Holz, leads modern Army from New York headquarters.

The Army has declared war against juvenile delinquency in five Southern states, experimenting with such weapons as group therapy and family role playing. Salvationists are providing food, shelter, and a ready rap for the victims of pimps and pornographers who frequent Boston's notorious "Combat Zone." A bilingual Army task force in Spanish Harlem has moved energetically from street counseling of drug addicts to dealing in the most human terms with child abuse and wife battering, as well as the problems of convicts renewing family ties and reentering community life after prison.

Indeed, three generations of Salvationists in this country have pioneered a host of social innovations and reforms now accepted as basic in any humane government's attempt to build a better life for its citizens. Summer camps for kids, hostels for the aged, halfway houses for alcoholics, assistance leagues for the deaf, mute and blind—all were innovations of the early Army, as were disaster relief, an adoption service, bureaus in which to seek employment or missing

Catherine Mumford Booth, the General's wife, pressed for equality of women in Army affairs.

Founder and first General of the Army William Booth began by preaching amidst London gin mills.

loved ones. Room and board for the down-and-out was always cheap but, except for the soup kitchens and shelters set up at times of natural calamity and during the Great Depression, never free. Salvationists persist in regarding pure charity as a degradation.

Long before civil rights was fashionable, the Army championed a degree of earnest integration unrivaled by any other organization. Consequently, perhaps, its facilities were often pointedly spared the orgy of arson and wreckage that convulsed the nation's inner cities during the riots of the Sixties. It also anticipated the women's movement. The words of the Army's founder, General Booth, ring as true now as ever: "Some of my best men are women." No wonder the Salvation Army recently found a phenomenal 97 percent recognition and 78 percent approval among Americans it polled.

Not all of its novel breakthroughs have proved entirely felicitous. Among the modern practices pioneered by the Army must be counted militant fund raising on a grand scale, for example, and a boisterous, almost Barnumlike penchant for public relations. A few of its antics have been downright hazardous to its own health: an early scheme to establish communal farm colonies, designed to deliver the urban poor from the iniquity of cities by breeding "the Landless Man to the Manless Land," turned out to be a big

U.S. Commander Ballington Booth and wife Maud "deserted" in 1896, set up Volunteers of America.

Dressed as a Piccadilly flower seller, Eva worked as one of them to know how it felt to be cold and poor.

failure. So did the vigorous and futile campaign to sustain prohibition, the Army's one major venture into national politics.

But it is hardly surprising that the Army should have made a few blunders in the first century, considering the paradoxical exploits of its flamboyant founding family, especially General William and his incandescent daughter, Evangeline.

The Salvation Army began altogether ingloriously in London in 1865. William Booth had metamorphosed as a young man from disillusioned pawnshop apprentice to puissant street preacher—in the words of one chronicler, "banging a Bible and waving an umbrella to attract attention," which came more often than not in the menacing form of dead cats and rotten garbage hurled with merciful inaccuracy by contemptuous inebriates. Still, with his bushy beard, scimitar nose and booming voice, Booth was a hellfire-and-brimstone prophet of Old Testament impact, a metropolitan Moses with a strong bent for military-style discipline.

Not only did Booth preach, Booth organized—too much, initially. The mission's 34-member governing board proved impossibly unwieldy for the messianic tastes of its growing cadres, most of whom were eager to act without waiting for formal policy decisions. Absolute top-down control of the rank and file, that was what was wanted, and before long the elder Booth was further moved to codify these martial sentiments with what he called *Orders and Regulations.* In realizing their command objective—which he defined as "getting saved and keeping saved and then getting somebody else saved"—Salvationists went military with a vengeance that would have made Mars himself smile. Posts were designated "Corps," devotional readings "rations," prayer "knee drill," the required weekly tithe from the Salvationist's pitiful recompense a telling "cartridge" in the ongoing fusillade against the Devil's dug-in bastions. To shout a fervent "Amen," furthermore, was nothing less than to "fire a volley" in that same battle. Births to an Army couple (in voicing the vows a spouse "enlisted" for the duration) were hailed as the welcome arrival of "reinforcements," death was an earned "promotion to glory."

Thus was the conflict joined. The General would interpret what God wanted, the troops, bless 'em, would obey like the stout soldiers in Christ they were. It was in this spirit that the Salvation Army entered into social service:

"Bramwell, there are men sleeping on the bridge,"

Jack Fincher is a free-lance writer based in Oregon. He wrote about the return of llamas to their ancient U.S. homeland in the December 1979 SMITHSONIAN.

An early recruit, Joe the Turk crossed the country defying local laws against preaching and parading.

When arrested, Joe preached to jailers and inmates, decorated his cells with a "Jesus Saves" rubber stamp.

the General informed his son late one night on returning home from an evening's ministry. "Do something about it."

In her own modest way Catherine Mumford Booth was equally formidable, as quiet and clever as her husband was stentorian and courageous. While her fiery William tilled the rude but fertile vineyards of the almshouse poor and roadhouse rowdy, his sedate wife cultivated a profitable harvest of guilt from the drawing rooms of the wealthy, collecting most of the funds that fueled the Army's purpose.

As if impelled to outfit the entire command structure themselves, the Booths produced eight children. One biographer characterized them as seven extroverts and one invalid: Bramwell, Ballington, Kate, Emma, Herbert, Marian, Eva and Lucy. Marian remained ill and inactive all her life as far as Army command was concerned. Bramwell became his father's chief of staff, an unintentional lightning rod for all the storms to come. All the other young Booths, at one time or another, were commissioned to far-flung outposts across the world, from India and Australia to Canada and Scandinavia, always in positions of utmost authority.

By no means the least of these scions was "Little Eva," born on Christmas day in 1865 and named by Catherine, who had been reading *Uncle Tom's Cabin*.

A column of prim if imperfectly disciplined troops—the Salvation Army lassies, as they were called—holds tambourine drill on makeshift parade ground in the Bronx. Picture was made in late Twenties.

From girlhood, the gift of self-dramatization became as natural—and as necessary—to her as breathing. Whether preaching to her dolls, drilling the kitchen help or racing impulsively outside to give her dinner to a beggar, Eva was consumed by a single confessed ambition: "Oh, God, help me someday to preach like Papa." Catherine Booth foresaw the day when Eva would not only preach like the General, but would lead the Army herself.

For all her gentility, Catherine was a staunch feminist who from the start won for the distaff side of the Army every right and duty its male counterpart had. Why should women be confined to the kitchen, she argued, any more than men to the field and shop? Exemption from one task or another for either sex meant that God had endowed a being with powers He never intended him or her to employ. God didn't work that way, concluded Catherine, and neither should His ministry on Earth. The General apparently saw her point, paving the way for the Army in America—and the world—to be later led by one of the most remarkable women in Western history.

The Army's first major assault on America was carried out by women. After several Salvationists had raised the banner here with promising results, the General concluded he could not spare any more officers to proselytize in America. But with Catherine Booth's support, the General's aide-de-camp, George Scott Railton, slyly proposed to lead a task force composed solely of expendable women recruits. Grudgingly, the General relented. In a memorable farewell prayer God was urged to drown the lot of them on the way if they were only to fail him on the firing line. On March 10, 1880, their steamer docked at New York City and Railton marched down the gangplank at the head of what he affectionately referred to as—behind mother Booth's back, no doubt—his "ignoramuses." Four days later the girls had their first convert, a pathetically endearing Bowery drunk named James Kemp. "Ash Barrel Jimmy," he was called, because he had once been discovered in one, head down and passed out.

By 1890, three years after Ballington Booth became American commander, the Army domestically had grown to 410 corps in 35 states. Free-wheeling Salvationists, reports historian Edward McKinley in his superb book, *Marching to Glory*, subpoenaed the Devil to mock trials and burned him in effigy, preached on eternity before empty coffins, wore prison stripes in the pulpit, rode horses onto the platform. Above all they paraded. For as McKinley astutely observed, "Everyone loves a parade, especially if he's in it." So completely did the Army remake the colorful street parade in its own provocative image that a cir-

The hungry lined up at Salvation Army center for Christmas baskets in the century's first decades.

A youngster points the way to a poor family's door as Salvationist delivers Christmas dinner, 1923.

cus rolling into Danbury, Connecticut, in the late 19th century was mistaken for a caravan of soul-savers and showered by irate drunks with rotten apples.

Meetings were equally theatrical, their watchwords "Everything short, sharp, striking, vigorous." According to McKinley, "Wifebeaters, cheats and bullies, prostitutes, boys who had stolen the family food money, unfaithful husbands, burglars and teamsters who had been cruel to their horses stood for their brief and glorious moments in the limelight of grace."

As the Army pushed its crusade ever westward, proselytizing all comers, the pages of its newspaper, *The War Cry,* resounded with crackling communiques from the front:

Sacramento sieged and almost captured, the Devil a liar mad and making the air smoky. Los Angeles under fire, five precious souls washed in the all-cleansing fountain . . . In San Francisco with God's help; we intend to fight Beelzebub clean over the fence . . . Bombarded Nevada City, one Tobacco demon killed. Attacked Monrovia and El Monte but the enemy as firmly entrenched as ever.

Among the proprietors and clientele of the gold-rush gin mills, as in the East, amused derision frequently boiled over into a murderous rage that triggered bitter, often violent resistance. Persistent Gospelers were shot, struck, knocked unconscious or their arms broken by flying bricks, sticks, stones or chunks of ice. They were cut, bruised, burned with cigars and firecrackers or threatened with lynching and "Dina might." One young officer's infant was slapped in the face. The reasons were many, the assailants as varied

A 1920s chow line at Army shelter provided meals for down-and-out men as a step toward rehabilitation.

as bored indolents bent on cruel sport and marginal entrepreneurs of vice challenged with ruin on their very doorstep.

Police often provided little or no protection, routing or arresting Salvationists for disturbing the peace, blocking the sidewalk, or violating hastily drafted ordinances aimed at keeping them off the street. It remained for the "Hallelujah Jail Bird," one Joe the Turk Garabed (p. 82), to take aim at the unconstitutional practice of denying Army workers their rights of assembly and free speech. Actually an Armenian, Joe the Turk frequently wore a fez and crimson pantaloons on a six-foot, 200-odd-pound prizefighter frame. A saved cobbler, he made it his business to test illegal arrests and local laws. Arrested 53 times, he always demanded trial by a jury which, being composed mainly of law-abiding churchgoers, usually set him free. Garabed meanwhile would do his powerful best to convert his guards and cellmates, holding impromptu prayer meetings and hymn sing-alongs, and tattooing the walls with his *Jesus Saves* rubber stamp for its next occupant.

But for all such unorthodox success, the Army found itself gripped by a crisis in command. Nettled over his brother Bramwell's growing authority at home and convinced the Army's achievements in America were not being fairly recognized, Ballington prevailed upon the aging General to make one of his rare visits to America. It was calamitous. Repelled by rampant "Yankee Doodleism," William Booth in a burst of Britannia-rules jingoism decided to shuffle all foreign commands. The Ballington Booths were ordered home. They rebelled, then resigned—"deserted"—to form the Volunteers of America.

Undaunted, the General dispatched daughter Emma and her husband Frederick Booth-Tucker (all men who married into the family were required to append its name to their own) to take command. But eight years later, Emma was killed in a tragic train wreck, her dispirited husband resigned, and in 1904 the U.S. command passed on to "Little Eva," who soon began calling herself Evangeline. She was 39 years old, English, and unmarried. But her 30-year reign—"no other word will do," insists McKinley—was to shape the Salvation Army in America.

Evangeline was an outstanding athlete who excelled at anything she played; an accomplished composer who wrote her own liturgical music and played the guitar, concertina and harp; an inspired molder and spellbinding spieler of marvelous sermons; a willowy and charismatic presence once described by a judge who tried her (for defying the law by marching with music) as having the face of an angel and the voice of a crow.

An unwavering teetotaler, she issued orders for a "Boozers' Convention" in which fleets of double-decker Fifth Avenue buses manned by Salvationists scooped up drunks and derelicts by the dozens and paraded the sorry lot of them back to the Mission. A water wagon bore the bodies of those too drunk to stand, walk, run away or resist. Marching Salvationists on either side caught those who chanced to fall "off the wagon," contributing if nothing else an indelible addition to the English language.

On the eve of the First World War, blinded and

Salvation Army doughnut girls were welcome sight for World War I doughboys fighting in France.

Still serving where needed, an Army captain walks a Bronx youngster to nearby Army day-care center.

weakened by cataracts in both eyes, General William Booth was promoted to glory. By terms of the rules he had laid down in 1878, William had left behind the name of his successor—Bramwell, naturally. When America entered the war Evangeline besieged General John Pershing with offers of a Salvationist contingent in France. "I have an Army," the smitten Pershing at first told her. "But not *my* Army," she shot back. Her instructions to one of the Salvation Army's legendary detachments of "doughnut girls" were equally typical in tone: "I promise you nothing. I don't know what you will go into; it may be life, it may be death; it may be sickness, it may be loss—I promise you nothing." Well, almost nothing. Her injunction to another group was reminiscent of the prayer that buoyed Railton's ignoramuses: "Anyone failing will be shot!" No one failed. So masterful a stroke of compassionate public relations was the war service that her unprecedented appeal for $13 million in a fund-raising drive at war's end was oversubscribed. Evangeline became the toast of the nation. Her most intimate supporters were presidents and kings, her most tacit suitors nothing less than princes—Galitzin of Russia, Philadelphia millionaire John Wanamaker, who was known as "The Merchant Prince."

But again the issue of succession reared its ungodly head. Bramwell, now 72, fell desperately ill. Who would be his heir? The choice, as before, was the General's to make. But this time the American corps commanders, led by an ambitious Evangeline, took action to depose Bramwell Booth in the name of a more democratic army. After an agony of debate and recrimination, Bramwell was toppled. But ironically the democracy Evangeline and her supporters had employed against him now led to her own defeat by Commissioner Edward John Higgins. The new Army had enjoyed quite enough Booths at the helm for the time being.

The Depression soon struck in all its sad fury. "Little Eva" stuck at her post and rallied her troops during the hard times. Salaries were cut, Army buildings mortgaged, new memos written on the backs of old ones, the long nightmare patiently endured and awakened from at last. But not until Evangeline, at age 68, had been elevated—without a vote to spare—to serve as the Army's fourth general.

By then of course another war was waiting in the wings to rescue the nation's economy from the consequences of its own excess. Almost forlornly, when it came, a national news magazine suggested the Army bring back the coffee and doughnut girls remembered so fondly. But this was a different war with different rules. The trench became the foxhole, the front, as far as the dogface went, extended everywhere. The 73-year-old Evangeline retired in 1939, leaving London for her home outside New York as the bombs began to fall on Poland. "It's stimulating to be shot at," she would later remark, "killing to be ignored."

On July 17, 1950, Evangeline Cory Booth was promoted to glory at age 84. She was buried in Valhalla, New York.

Problems of a 'peacetime Army'

Today, with the blood and fire of the last Booth gone from its top leadership, the Salvation Army in America, if it hasn't become a monument to what it once was, at least shows the faint but unmistakable signs of starting to mellow like peacetime armies of every age. The number of corps has declined, its 112,000 soldiers, recruits and adherents have by no means kept pace with population growth, and the street-corner meetings of its open-air ministry have shrunk by almost half, while such words as "teas," "garden parties" and "fashion shows" increasingly creep into its formerly fire-breathing literature. The good Salvationist probably would deny it, of course, but when one of the characters in a dramatization based on Vachel Lindsay's poem *General William Booth Enters into Heaven* —which was performed at last summer's centennial celebration in Kansas City—exclaimed, "When the Army worries about its good name, it's done for," the cheers that came from the crowd of 12,000 uniformed delegates were more a matter of nostalgia than affirmation.

For the Army does worry. In recognition of its centennial it commissioned a "Battlefield Report" whose drafters canvassed more than 2,700 officers, 1,400 sol-

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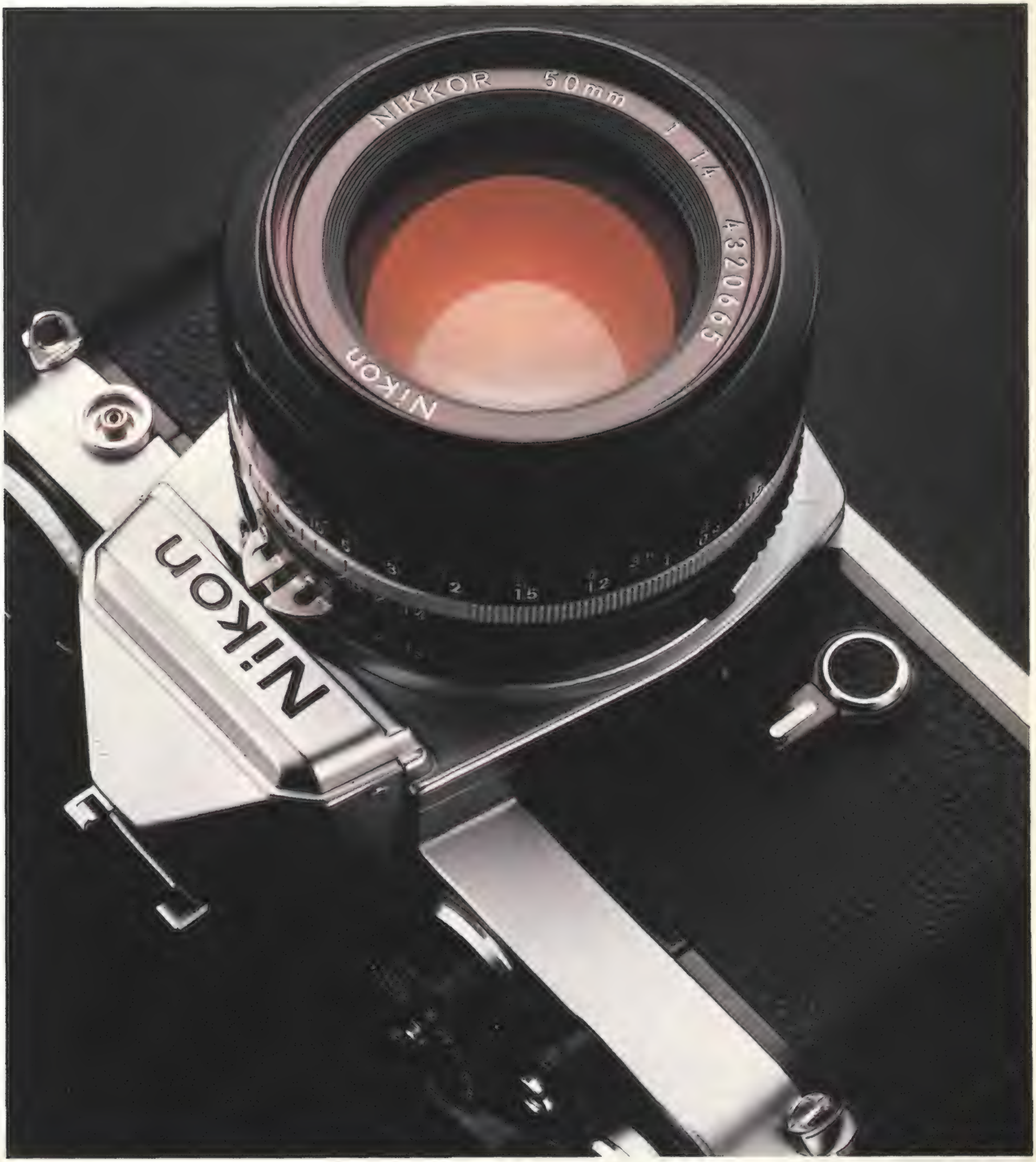


diers, 2,500 board advisers and 12,000 donors on what they thought of the current Army and its work. From their answers, the Army command concluded with more than a trace of corporate angst that there was "a striking lack of real understanding" of its basic purpose and programs today among its many "publics," a failure to appreciate its "balanced ministry approach of spiritual and social outreach," a "lack of full commitment" sensed by soldiers and officers among its leadership, a clear need for new sources of funds as well as better training. The noun "publics" was the tipoff. It was born not in Railton's Bowery or on Booth's East End but in the less hallowed halls of Madison Avenue.

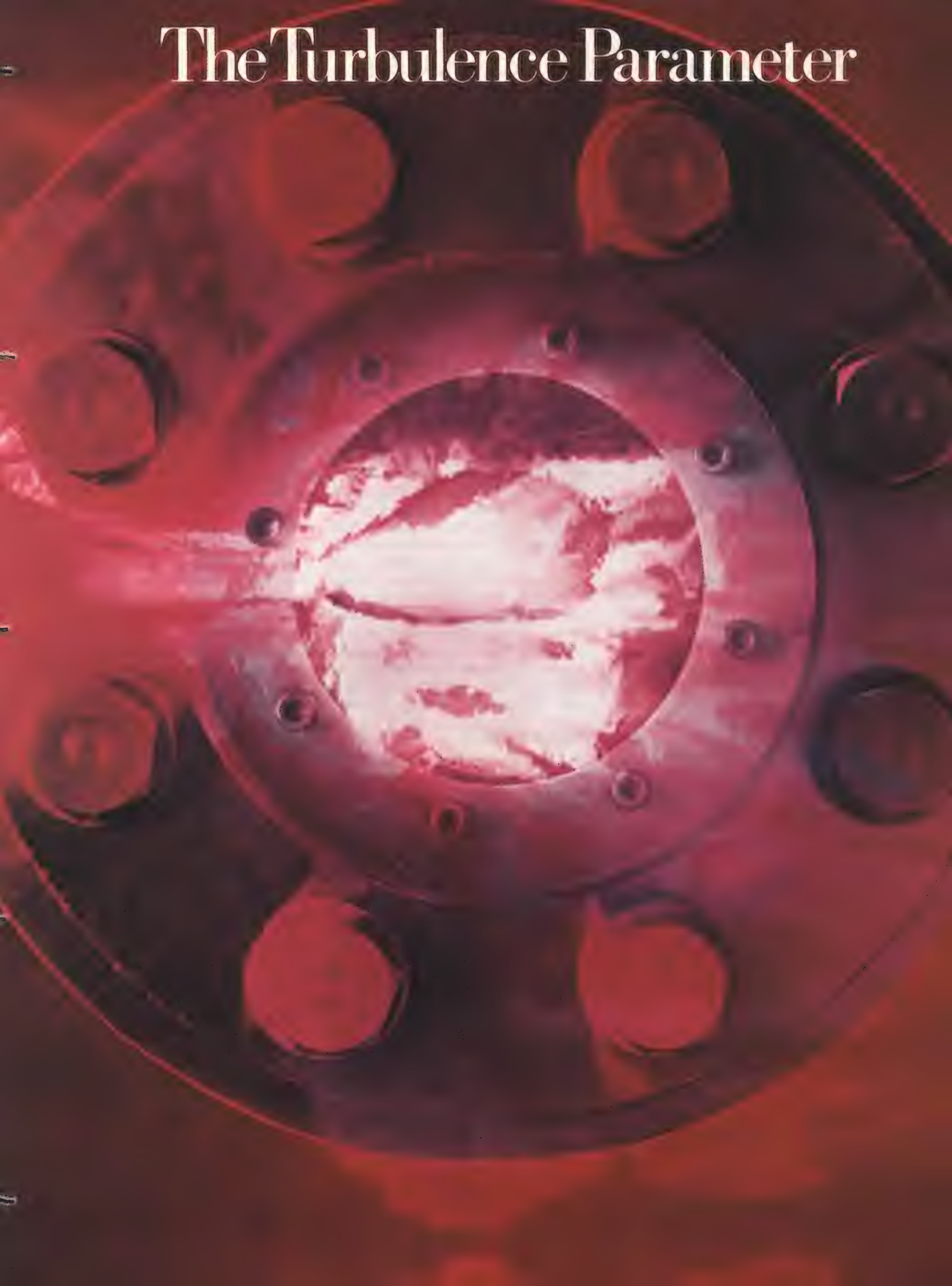
Indeed, the Army's 17th National Commander, a third-generation German-American officer named Ernest W. Holz, is as much at home with auditing and accounting as he is with fund raising and mass-media communications. He is chief administrator and president of the 12 corporate entities that make up the Army's $819 million holdings in the United States. He coordinates the Army's programming, accounting and training curriculum, serves on the boards of six other national service organizations, is the Army's U.S. envoy to the diplomatic corps of 83 countries, supervises promotion and large-scale building within the four regional territories, and personally presides over its national headquarters in New York and a six-person Washington office that deals with disaster relief and lobbying Congress.

A man as friendly as his 30 years in Rotary International would suggest (yet one regarded as intensely private by his associates), Holz recognizes as much as anyone how the Salvation Army has changed since he entered its service 40 years ago. "The Army has changed from personalities to policy," he says crisply. "In the modern Army, I'm afraid, Joe the Turk would be very much out of step."

Band member holds out tambourine for donations, a longstanding Salvation Army tradition.

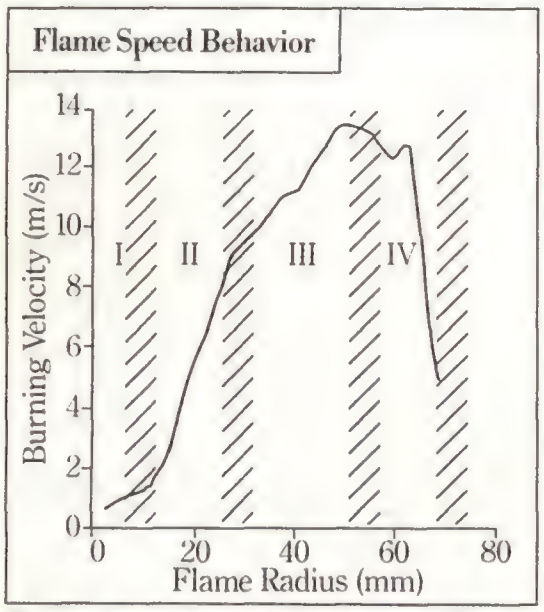
The number of street bands has been reduced, as the Army is modernizing, but the melody lingers on.

The Turbulence Parameter



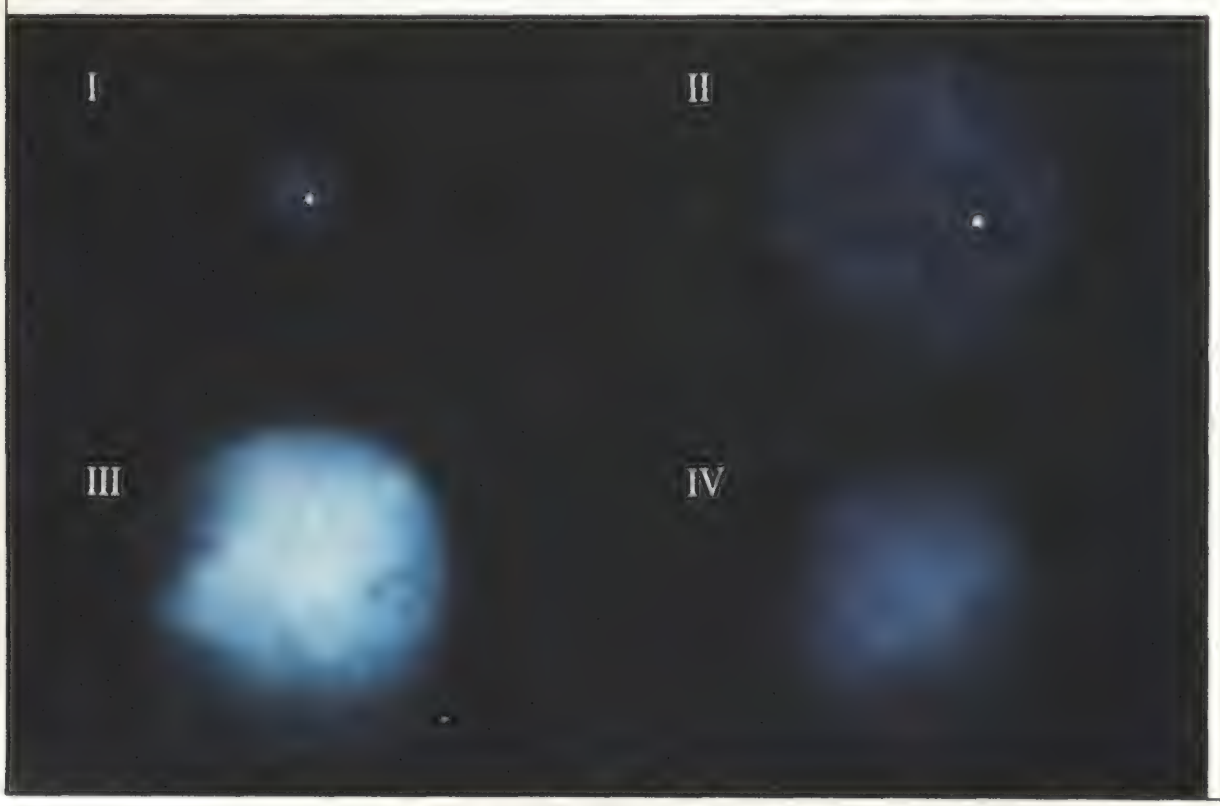
The Turbulence Parameter

Energy-efficient operation of the internal combustion engine requires the highly turbulent movement of fuel and air in the chamber. Recent advances at the General Motors Research Laboratories provide a new basis for determining what degree of turbulence will get the most work from each drop of fuel.



Burning velocity plotted as a function of flame radius. Combustion stages are indicated by roman numerals.

High-speed photographs showing flame evolution (lasting six milliseconds) through four stages: initiation (I); flame growth (II); full development (III); termination (IV).



WITHOUT TURBULENCE, the highly agitated motion of cylinder gases, combustion would take place too slowly for the gasoline engine to function. Predicting combustion behavior in order to design engines with greater fuel efficiency depends upon understanding the relationship between vital, turbulent gas motions and burning rate. The challenge is to quantify this relationship—a complex task made more difficult by the requirements of measuring a transient event occurring in a few milliseconds within a small, confined space.

New knowledge of how turbulence affects flame speed has been revealed in fundamental studies conducted at the General Motors Research Laboratories by Drs. Frederic Matekunas and Edward Groff. Their investigative results have been incorporated into a model that successfully predicts the effect of engine design and operating conditions on power and fuel economy.

The researchers separated their experiments into two phases. In the first phase, they measured turbulence in the engine cylinder; in the second phase, they determined flame speeds over a broad range of operating conditions. Testing took place in a specially designed, single-cylinder engine equipped with a transparent piston to permit high-speed filming of the combustion event.

Hot-wire anemometry was applied to measure the turbulent flows while the engine was operated without combustion. Instantaneous velocities were calculated from the anemometer signals and simultaneous measurements of gas temperature and pressure. More than 400,000 pieces of data were processed for each ten-second measurement period.

The significant measure of turbulence is its "intensity," defined as the fluctuating component of velocity. Because conditions in the cylinder are both transient within cycles and variant between cycles, separating the fluctuating and mean components of velocity is inherently difficult. The researchers overcame this problem by using a probe with two orthogonal wires properly aligned with the direction of the mean flow.

In the combustion phase, tests were performed at over one hundred operating conditions of varied spark timing, spark plug location, engine speed and intake valve geometry. Detailed thermodynamic analyses were applied to the recorded cylinder pressures to calculate flame speeds throughout combustion. High-speed films were analyzed frame by frame to validate flame speeds and to characterize how gas motions influence the initial flame.

The researchers used these measured flame speeds, turbulence intensities, and the conditions under which they occurred to formulate a burning law for engine flames. They divided the combustion event into four stages. The initiation stage begins with ignition and ends as the flame grows to consume one percent of the fuel mass. In the second stage, the flame accelerates and thickens in response to the turbulent field. The third stage exhibits peak flame speed. In the final stage, the thick flame interacts increasingly with the chamber walls and decelerates.

OVER THE RANGE of turbulent intensities encountered in engines, the researchers were able to describe the turbulent burning velocity, S_T, during the critical third stage of combustion with the expression:

$$S_T = 2.0\, S_L + 1.2\, u'\, P_R^{0.82}\, \beta$$

S_L, the laminar flame speed—a known function of pressure, temperature and mixture composition—is the flame speed that would exist without turbulence. The variable u′ is the turbulence intensity. P_R represents a pressure ratio accounting for combustion-induced compression of the unburned mixture. The dimensionless factor β accounts for the effect of spark timing on geometric distortion of the flame which occurs during the first combustion stage and persists into the later stages.

The researchers also observed that the burning velocity in the second stage increases in proportion to flame radius, and that in predicting the energy release rate from the burning velocity equation, it is necessary to account for the finite flame-front thickness.

"The form of our burning equation," says Dr. Matekunas, "shows a satisfying resemblance to expressions for non-engine flames. This helps link complex engine combustion phenomena to the existing body of knowledge on turbulent flames."

"We see this extension," adds Dr. Groff, "as a significant step toward optimizing fuel economy in automotive engines."

THE MEN BEHIND THE WORK

Drs. Matekunas and Groff are senior engineers in the Engine Research Department at the General Motors Research Laboratories.

Both researchers hold undergraduate and graduate degrees in the field of mechanical engineering.

Dr. Matekunas (right) received his M.S. and Ph. D. from Purdue University, where he completed graduate work in advanced optics applications.

Dr. Groff (left) received an M.S. from California Institute of Technology and a Ph. D. from The Pennsylvania State University. His doctoral thesis explored the combustion of liquid metals.

General Motors welcomed Dr. Matekunas to its staff in 1973, and Dr. Groff in 1977.

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Article and photographs by Vic Banks

Our cacti have met the enemies– and they are us

Imperiled desert plants are in such demand for landscaping and collections that even special police cannot adequately protect them

Rare crested saguaro cactus, towering 20 feet above the desert, is a type especially in demand.

"I'm armed 24 hours a day," says the burly Arizonan whose job it is to catch people who have a larcenous affinity for cacti. His name is Richard Countryman; inserted in each copy of the Native Plant Law that his corps of "cactus cops" and the Arizona police carry in their patrol cars are these words: "In stopping all persons for questioning who are hauling or digging cactus, it is advisable to use CAUTION! The behavior of such persons is unpredictable."

A botanical nightmare is in progress in the American Southwest, and all the jokes about "prickly problems" and "thorny questions" won't make it go away: native cacti are in trouble. Although the dangers to species survival are now focused in the Sun Belt, in the long run cacti could be imperiled in every state except Hawaii, Alaska, Vermont, New Hampshire and Maine —the only places where none grows.

Some of America's more than 250 existing species are already "vulnerable to extinction," according to Dr. Lyman Benson, an authority on desert plants. He itemizes the "chief threats" to wild cacti: commercial demand for a plant; overzealous collecting for private gardens and greenhouses; growth of housing developments, particularly in Florida and the Southwest; agriculture, which has already "tended to eliminate the smaller species"; grazing, "usually unfavorable . . . especially to small species or to the seedlings of large species. . . . If goats are present, not much else is"; and fire, which upsets the ecosystem.

Professional cactus hauler Scotty Farmer secures giant saguaro just loaded on his hoist-rigged truck.

For the ravenous collectors of wild plants, Gary Lyons of the International Organization for Succulent Plant Study offers no pardon but at least some comfort. The worst offenders, he believes, are strip miners who "churn the land for its mineral wealth and leave it as lifeless as the surface of the moon." He might want to add the Arizona copper-mining company that recently destroyed, albeit with state permission, hundreds of giant saguaro cacti at a mine near Tucson because salvage operations would be costly and even hazardous. Local conservationists were outraged, as were local landscapers and the cactus haulers who "harvest" wild plants for a living: prices for saguaros are so high that, given the chance, they would have dug them up. Which leads to Lyons' proposal for saving the cacti: "Expand the existing preserves—like the Saguaro National Monument—but where land development *is* going on, make some arrangements to salvage the plants—for private, public or commercial use—and move them to new locations within or near their natural ranges."

Arizona cactus cop moves Joshua trees—maybe dug illegally—from nursery to state-run holding area.

Landscaped with cacti, this 1920s house presaged the residential demand for desert plants today.

And so there are cactus wars among collectors, conservors, destroyers, dealers and government regulators, with Arizona the most active battlefield because it has the toughest laws against removal, destruction and mutilation of its 212 protected plant species. Within the state there are 45,000 square miles of prime cactus-producing land, which makes regulation difficult, particularly with respect to "haulers," the entrepreneurs who seek wild cacti in the deserts. Haulers have acquired an unsavory public image over the years, not always deserved. Many have government permits to conduct legitimate business with landowners and nurseries. But to Richard Countryman (opposite), director of the state Commission of Agriculture and Horticulture Compliance Division, chasing the rustlers among them is a sacred mission.

"That's all we've got. In northern climates, rainfall encourages trees to come back just like that," says Countryman as he snaps his fingers. "But once you clear off whole sections of desert plants here, it causes wind erosion, and when it rains, it rains like hell, washing everything away. Besides, it takes a lifetime for many of these plants to be replaced. A saguaro, for instance, needs a year to grow just one-half inch; during its 150-year life, it produces millions of seeds, but less than ten reach maturity to continue the species."

Countryman came to Arizona in 1929, the same year the legislature passed its Native Plant Law, the first of its kind in the nation. "Even back then," he laments, "people were coming to the state not only to escape winter but for health reasons. We realized we had some unique and unusual plants here, but somebody

At Phoenix holding area, confiscated trees are planted temporarily, while source is investigated.

Arizona's Richard Countryman (dark shirt) looks for digging-permit tags on hauler's load of trees.

was always ripping them off or shooting them up." He showed me a letter from then Governor George Hunt in 1932 warning of "the wholesale despoliation of desert flora in Arizona by commercial firms. . . . The extinction of many of the rare and beautiful forms of cactus that adorn our desert is imminent unless this practice is stopped."

With thousands of retirees and winter tourists taking up residence in Phoenix and Tucson, there has been a heavy demand for attractive plants to landscape the rows of new houses and condominiums being built. Desert plants are popular because they require little maintenance and thrive on the area's meager rainfall. "Besides, they're real cute," Countryman continues. "We figured that after the '29 law, ten percent of the tourists were still taking plants home—by the mid-1960s in excess of 150,000 a year."

In 1967 the state legislature attempted to put some teeth into the law by establishing a Compliance Division—the cactus cops—to enforce the existing plant-permit system. It authorizes specific types and numbers of plants to be transported from a designated area, usually private property where the owner has granted permission. It also requires purchasers of cacti to keep permit tags as proof of legal sale. First violations are "misdemeanors, punishable by a fine of not more than $500 . . . or by imprisonment in the county jail not to exceed 30 days, or both." In 1970-71, 1,145 permits to collect cacti were issued; in 1977-78, more than 3,000. For 1979 alone, more than $1.8 million dollars worth of cacti was legally dug from the wild. Business is blossoming.

But unlawful collecting of cacti is blossoming, too. "Illegal haulers are hard to keep track of," says Countryman. They often work at night to avoid detection. Officials have estimated that nearly half a million dollars worth of plants is stolen each year. He adds, "It's as profitable as cattle rustling used to be."

The Compliance Division's six full-time plant investigators made 91 arrests in 1979—up 100 percent from 1978. To see how the patrol system works, I join Bill Gorman, a cactus cop (who later quit to become a plant wholesaler), on his regular rounds through the streets of Phoenix in a white radio-equipped pickup, looking for violations. Apparently everyone loves cacti: trailer courts, housing developments, shopping centers, even roadside taverns and a number of churches have at least one saguaro, organ pipe, hedgehog or barrel cactus in their yards.

"Part of the problem," explains Gorman, "is that many newcomers bring with them their Northeastern life-styles—energy- and water-intensive like air conditioning and lawns." To discourage lawns, the state gives at least tacit approval for desert landscaping, inadvertently underwriting the demand for cacti.

Gorman's radio crackles alive with directions from headquarters to check on some plants at a wholesale nursery. On arrival, he grabs a shovel from the truck. As we enter the cactus-holding area, he explains that abuses of the plant-permit system abound. Many haul-

Vic Banks last wrote for SMITHSONIAN *about bald eagles in Alaska (December 1979). He specializes in articles on environmental and wildlife subjects.*

Near his loaded truck, hauler displays staghorn chollas he had permission to dig up on private land.

ers make arrangements with private landowners for permission to take cacti from their property, but, after obtaining permit tags, the illegal haulers among them cross over to neighboring federal or state land where collecting is prohibited, dig up the forbidden cacti, sell them on the black market and reuse the same tags over and over again.

Bill soon calls me over to look at several five-foot saguaros that do not have tags showing and will likely be impounded. Probing, he digs about ten inches into the sand around the base of one and finds a tarry substance oozing from its chopped roots. "Necrosis," he says, "a tissue infection that comes from mistreating the plants." Then he shows me an ocotillo, a plant commonly used in landscaping. At its base, just below the sandy soil, he points to deep gashes in the bark. "They're chain marks. Some haulers in a hurry to pile up plants in the truck drive through the desert using heavy link chains wrapped around the bumper to tear out cacti and plants like the ocotillo by the roots [p. 100]." The chances for their survival are slim. Because cacti grow at an excruciatingly slow rate, it may take well over a year for a plant to die.

Perhaps the most subtle form of "cactus-napping" is the widespread stealing for personal collections. For certain collectors, cacti present bizarre and rare species which become the cherished porcelains of desert botany. To help me understand their zeal, Gorman took me to an expert on cacti and their cultivation, Dr. Clint Callahan, then living in Phoenix. His front yard was a desert version of a Japanese pebble garden, designed to show off hundreds of cacti to their best advantage. He was developing a breeding stock of rare cacti by trading with other collectors, grafting and growing from seed—not by buying from haulers. A veterinarian by profession, he freely admits his love for cacti: "I get chills when I walk into a nursery and see plants I don't have. Many cacti give us marvelous fruits which form an important food source for native Indians as well as birds and insects. If you didn't have saguaros and chollas, you wouldn't have the variety of Sonoran Desert fauna. That's why I'm against wholesale raping of the desert. In Texas near the Big Bend region, I've seen piles of rotting rainbow cacti three feet high, just stinking. Apparently haulers picked too many and couldn't pack them up in time. Then it rained and the plants spoiled."

By now I am genuinely curious about these men who make their livings—good livings—by digging plants from the desert, so I ask a few more collectors about the haulers. A lot of names are mentioned, but one is consistently repeated as being tops in the field: Scotty Farmer.

Farmer is the image of a self-assured desert entrepreneur. His weather-beaten skin, faded jeans, worn cowboy boots and straw Western hat with rolled brim make you think he just stepped out of a cigarette ad—at 53, a real cactus cowboy. He invites me to come with him on a job about 55 miles northeast of Phoenix. He has paid a corporation a fee for permission to take cacti from more than 40,000 acres there. We jump into his customized one-ton flatbed truck that resembles some kind of missile launcher. Under the hood is a special 450 horsepower Chevy V-8 linked to four-wheel drive; it guzzles gas, but sure beats cow ponies for the 100,000 miles Farmer drives yearly hauling cacti.

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Chain tightens between base of ocotillo and truck's bumper as driver backs away and uproots plant.

Hauler proceeds to load uprooted ocotillo. Though roots appear intact, plant could be damaged by chain.

The real advantage of this off-the-road vehicle is the hydraulic hoist on the back. "Cacti," says Farmer, "are like big watermelons. Smack 'em hard and they'll split in half. This hoist can lift huge cacti in excess of five tons without so much as breaking a thorn," he boasts. As we roll along the highway, he tells me that during the past 13 years he's hauled cacti from Nevada, Utah, California, Texas, Arizona and Mexico. And he's supplied them not only to local landscapers but to customers in Palm Springs and overseas exporters. He once drove a semitrailer full of cacti to a Manhattan dealer, and he's helped a wholesaler get a special cactus for shipment to Monaco.

Once we escape the city's seemingly endless string of franchise restaurants and shopping centers, the desert becomes a rich tangle of vegetation: green paloverde trees, mesquite, prickly pear cacti, staghorn chollas, barrel cacti, stately saguaros and patches of creosote bushes carpet the land in every direction. "See that saguaro?" says Farmer. He points to a 15-foot beauty. "I can load that in 12 minutes, sell it for $250." Saguaros are $20 per running foot, more if they have arms. One with a bulbous mutation growth at the top —a cristate or crested saguaro—is rarer and can sell for from $2,000 to $6,000.

"Real big" cactus is a hauler's dream

We stop to open a barbed-wire cattle gate and cross onto corporate property. As we bounce along the road, it narrows and twists around bushes and ocotillos. Then we plow over a riverbank to the dry Hassayampa and bang along its rock-strewn bottom. Farmer slips into four-wheel drive, and the engine's whine scares up a covey of quail. A cactus wren flitters to safety in the arms of a dense cholla; suddenly a huge jackrabbit runs a panic escape route right in front of our wheels. "Over there," Farmer points. Halfway up an arroyo a perfect saguaro towers nearly 22 feet above the desert. He's promised it to a customer. I ask if there is something special about it? "Yeah," he barks, "it's real big."

We are soon joined by Farmer's son, Mike, who promptly starts digging around the saguaro's base to expose the main and surface roots; they're as big around as a man's biceps. Next he pulls a double-bladed ax from the truck and severs the roots while Farmer raises the hoist skyward. They pad a wooden cradle with burlap bags, fasten steel braces around the cactus trunk and secure it to the cradle. With the sound of a garbage truck, the hydraulic lift strains, tilting the cactus by a few degrees. Then they run a heavy chain across the cut roots and winch it tight, drawing the entire cactus up into the cradle. More padding around the arms finishes up the job (p. 94). It's been just 28 minutes. Patting the cactus gingerly,

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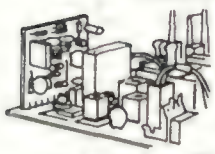

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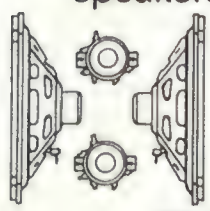

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Features available on selected System 3 models and screen sizes. Shown: The Andantino, model SM2575E. Mediterranean styled console. Genuine Oak wood veneer top and sides with parquet top. Decorative front and base of simulated wood in matching finish. Simulated TV picture.

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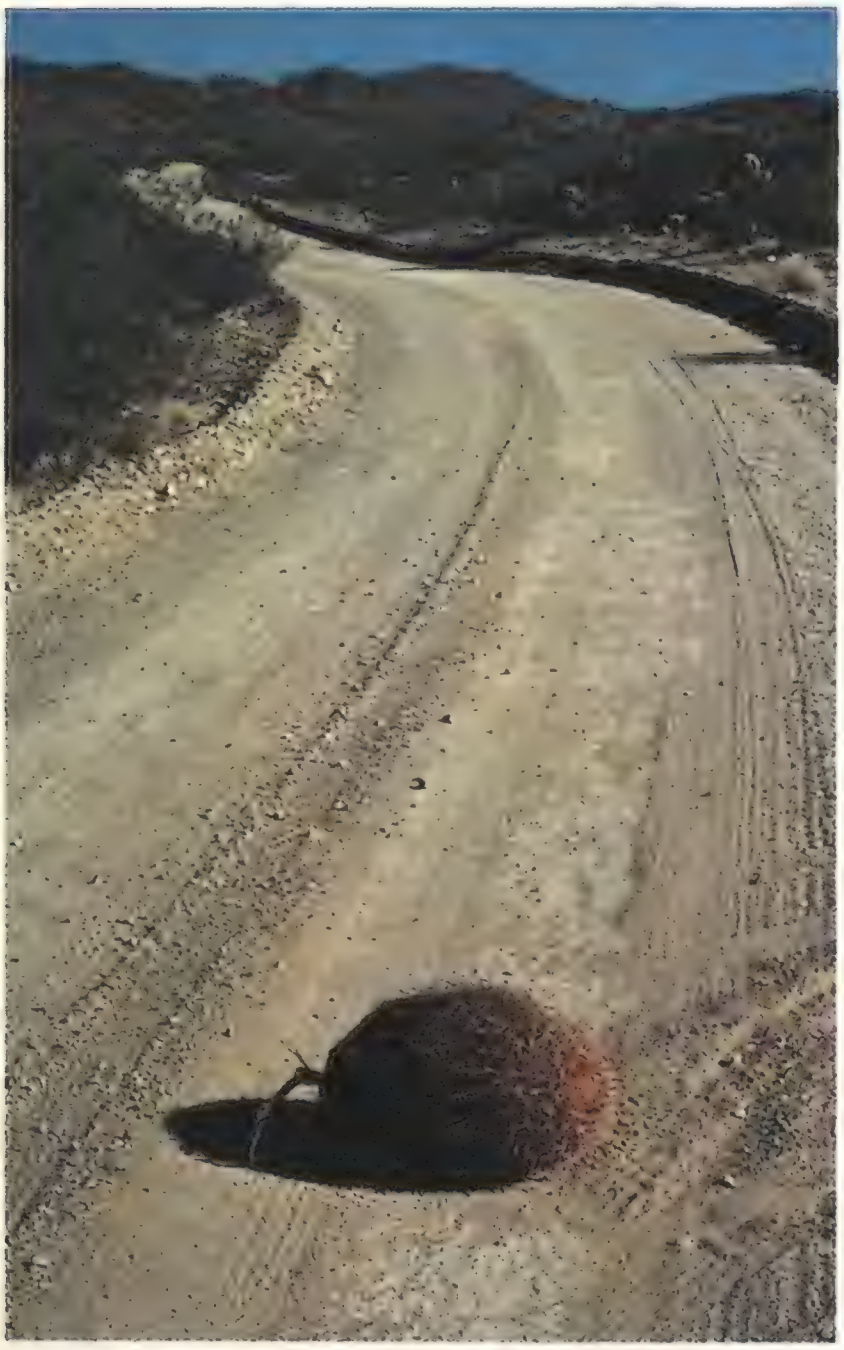
Farmer grins: "This one is $400, and that's wholesale."

In 1979, 275,000 leaflets on the perils of plant collecting and on the Native Plant Law were distributed by Arizona's Commission of Agriculture and Horticulture. One hundred and six talks were given to garden clubs and at schools and county fairs—200 hours' worth—in an attempt to educate the public. If the word is getting out to people in Arizona to protect their native plants, the message pretty much stops at the borders. Countryman later showed me hundreds of green cards that are filled out when someone transporting plants wants to cross into his state, one of the few that has inspection stations on its boundaries. Tens of thousands of plants, mostly cacti, come in from neighboring regions to meet the insatiable demand.

Arizona is a microcosm of the broader interstate, international cactus-trade dilemma. Even though the federal Endangered Species Act prohibits interstate trade of *some* cacti, only candidates for extinction make the list. Conservationists like Faith Campbell of the activist Natural Resources Defense Council are suggesting that *unlisted* plants be protected under other federal legislation at least to set "sustainable levels" of exploitation. Being drafted are increased protective measures for international trade: designating the ports through which imports and exports of federally protected plants must move; placing plant inspectors at these ports; licensing exporters and importers. A smuggling-detection program is also planned. Until new safeguards can be implemented,



Telltale tire marks turning to right of fallen barrel cactus, led the author to a hauler's truck.

If Arizona's cactus cops fail, scenes like this one may someday occur only within its desert preserves.

harmful trafficking in cacti thrives—a growth industry.

But even growth industries are vulnerable. Private citizens can help reduce the illegal cactus trade by, obviously, not digging up wild plants, but they might also question their plant dealers about sources: nursery-grown or field-collected cacti? If they're wild, no sale. And anyone can examine a plant—especially a large one—for bruises; cultivated cacti should not show any damage.

When I returned to Chicago to write this story, I passed a plant store on the city's fashionable North Side. There, sitting near several palm trees, was a large, exceptionally fine potted cactus with a price tag of $140. Hauled legally? Seed-raised? Stolen? My thoughts returned to another hauler I'd talked with in Phoenix, a bona fide veteran of the cactus wars. "Twenty years ago," he recalled, "hauling was a lucrative business—I worked ten different states for cacti. I could take a truck into the desert and in about three hours come home and plant them in someone's yard and make two to three thousand dollars; landscaping, they call it. There were only maybe 20 of us brokers in Arizona then; now there's probably 500-600." His market may be tightened, but the money still comes in—from other states, from Japan, Germany, Holland, Saudi Arabia—maybe even from Chicago. Have the plant laws and cactus cops affected his future? He pulled out a couple of architectural renderings of Western-style homes nestling among some cacti. "Me?" he winked, "I'm becoming a landscape designer."

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While blimp plugging Hughes' film *The Outlaw* sails overhead, "Goose" is moved to Long Beach for

assembly in 1946. Only house movers could handle the cradled, 219-foot-long hull of the gigantic airplane.

In October, before final move next spring to its new home, aircraft is towed to interim berth.

By Stuart Nixon

Big 'Spruce Goose' will settle down soon in a new nest

After sitting 33 years in guarded seclusion, the world's largest airplane will join the Queen Mary *in California tourist complex*

What is wider than a football field, floats on water, weighs 200 tons fully loaded, comes equipped with 448 spark plugs, and is held together with glue?

Answer: the world's largest airplane.

Howard Hughes built it during World War II—an all-wood seaplane variously designated the HK-1, the H-4, and the HFB-1, but best known by the unelegant title bestowed upon it by a skeptical politician: "the Spruce Goose."

Hughes, not surprisingly, wasn't amused by the

Fuselage of the "Goose," fashioned of laminated sheets of birch plywood, takes form in a hangar in Culver City. The airplane cost about $40 million in 1940s; today the cost would be about $160 million.

name; not only was it facetious, it was inaccurate: the aircraft is made primarily from birch. Even today—four years after Hughes' death—people who used to work for him are careful not to use the term. They refer to the aircraft simply as "the flying boat."

By any name, the aircraft is big: 320 feet from wing tip to wing tip—60 percent wider than the wingspan of a Boeing 747. From the hull to the top of the tail, it rises 80 feet, easily beating the 747. Inside, the flying boat had room for 700 troops.

The Hughes plane has been sitting in a dry dock at Long Beach, California, the same place it has been since its first and only flight in 1947 (a short hop that lasted about a minute). This was typical of Hughes, who collected airplanes like stamps, then put them in hangars and walked away, hiring people to maintain them but never flying them again. He may just have had too many irons in the fire, unable to make up his mind whether to be a movie producer of films like *Hell's Angels*, with Jean Harlow, or a test pilot (he was nearly killed in several crashes), or a big defense contractor, or (as he did) to pursue all three careers.

The aircraft is now beginning a journey to a new site at Long Beach, where it will be put on display next year as part of a tourist complex alongside the *Queen Mary* ocean liner. For the first time in 34 years, the public will get a chance to look at the monster.

The idea for a giant flying boat originated not with Hughes, but with Henry J. Kaiser, the shipbuilding wizard from Oakland, California, who found America facing a predicament in the summer of 1942: German U-boats were sinking his mass-produced Liberty Ships faster than he could build them. Kaiser gave a speech in which he called on President Roosevelt's War Production Board (WPB) to convert shipyards to aircraft assembly lines, and to begin development of extremely large transports that could haul bigger payloads than any aircraft then being designed.

Kaiser took a train to Washington in hopes of selling his idea to Congress. Preceded by a lot of favorable publicity generated by his speech, he boasted to a Senate committee that he could start turning out flying boats in ten months if the government would put up the money. Over at the WPB, almost everybody thought he was crazy. What, after all, did he know about airplanes? WPB chief Donald Nelson, however, wasn't so sure. Henry Kaiser had been right before. Turning him down might be bad public relations. Nelson told Kaiser to build three prototype aircraft.

Hughes, at this time, was living in Los Angeles, where he had put together a group of engineers and

Stuart Nixon, who writes on aviation and space, is senior editor of the Air Line Pilot *in Washington.*

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In an uncompleted Long Beach dry dock, huge wings are moved into position for attachment to fuselage.

designers operating as Hughes Aircraft Company. For three years, he had been trying to sell the Army a design for a bomber called the D-2, which he proposed to construct from wood, using a new bonding process called Duramold, making waterproof plywood by impregnating wood veneers with synthetic glues.

While Kaiser was in Washington, one of Hughes' associates heard about Kaiser's proposal on the radio and asked Hughes whether he might want to talk to the flamboyant shipbuilder. When Kaiser returned to the West Coast, the two met in a hotel room. At first, Hughes thought Kaiser had lost his mind—designing even a simple plane was an enormously complex task. But after thinking it over for several days, Hughes accepted Kaiser's offer.

During the fall of 1942, Hughes' staff at Culver City (site of the Hughes Aircraft Company) came up with numerous designs, settling on one that was capable of carrying perhaps the heaviest payload in the military's inventory: a loaded 60-ton Sherman tank. To build the aircraft, Hughes proposed to use Duramold plywood, since the government wouldn't give Kaiser any metal. To make the plywood, Hughes chose birch, which offered a good strength-to-weight ratio and was readily available. Signing U.S. Plywood as his primary supplier, Hughes sent inspectors to Wisconsin, Michigan and other locations to watch the lumberjacks cut down the trees and haul them to the mill to be sliced into very thin sheets. Once U.S. Plywood had selected the sheets, Hughes inspectors made their own check of the material for knots, discoloration and other flaws. The veneers that passed this test were shipped to Culver City.

In California, Hughes' technicians put the wood in climatically controlled rooms to equalize the moisture content of all pieces. Then came the massive job of making the plywood panels.

Some parts of the aircraft could be made from a single Duramold panel, but most parts—such as the skins—were so large they had to be made from multiple panels, using special joints. These joints, like all others in the aircraft, were bonded with glue. There are no nails, screws or rivets anywhere in the basic airframe. Much of the joint-making had to be done by hand. "We pretty much cornered the market on highly skilled cabinetmakers," one engineer recalls.

Engines for the aircraft were government-furnished, as were the propellers and avionics. Hughes chose the biggest power plant available: the Pratt & Whitney R-4360, which produced 3,000 horsepower. Each of the eight engines contained 28 cylinders.

It was not possible to construct the main sections of the HFB-1 (Hughes Flying Boat Design No. 1)—wings, fuselage, tail, etc.—in any of the existing facilities at Culver City, which were all too small. Instead, Hughes erected a new hangar 750 feet long, 250 feet wide and 100 feet high—enough to enclose more than four acres of floor space. For its time, the building (which still stands) was a colossus.

An elusive, eccentric boss

A continuing problem was Hughes' unorthodox style of management. He had no office at Culver City and rarely showed up there. His engineers had to see him at his home or elsewhere—usually late at night—or talk with him by telephone. At the factory, a former aircraft mechanic named Glenn Odekirk held the title of general manager, but Hughes didn't give him authority to make critical decisions. On paper the head of the project was Neil S. McCarthy, Hughes' Los Angeles lawyer, but biographers of Hughes claim that McCarthy "knew nothing about aviation, and was even afraid to fly . . . Thus, no one was there on the site, in charge of the flying boat on a day-to-day basis."

From the scale of the HFB-1 project, it became apparent to officials in Washington that any hope of buying flying boats from Howard Hughes was pure fantasy. The technical problems alone were enormous. Soon, the military began to look elsewhere for solutions to the submarine menace, prompting Donald Nelson at the WPB to cancel the Hughes contract in

THERE is an air of insatiable desire about Shalimar.

The inspiration for this classic fragrance came from the story of a man who loved a woman so deeply, that when she died, every fiber of his being was devoted to creating a monument to her memory.

Twenty thousand men labored daily for twenty-two years to fashion marble into the pinnacles, parapets and domed kiosks we know today as the Taj Mahal.

The garden where their love grew was called the Garden of Shalimar.

Shalimar, the most exquisitely voluptuous perfume on Earth, by Guerlain.

guerlain
PARIS

Unveiling of sequestered 'Spruce Goose'

On platform above hull Hughes (as always, in fedora) inspects one of the craft's eight 3,000-hp engines.

early 1944. Hughes protested and managed to get the contract reinstated. This time, however, Nelson eliminated Kaiser from the program (much to Kaiser's relief) and called for construction of only one aircraft, not three.

For the next two years, the pieces of the flying boat gradually took shape at Culver City. Finally, in the summer of 1946—ten months after the Japanese had surrendered—Hughes was ready to assemble the aircraft. Now investing his own money to keep the project alive, he leased a site at Long Beach Harbor where he could build a dry dock next to the water. Beginning in June, he moved the basic sections of the huge plane from Culver City to Long Beach, 28 miles away. The move was an event in itself, requiring two days for most pieces to make the trip.

Overhead a blimp hovered (pp.106-07), bearing an ad for Hughes' movie *The Outlaw*. Then in his early 40s, Hughes was something of a public relations genius but already was showing the eccentricities that would mark his later life. At times when he should have been minding his store he had left flying-boat construction largely unbossed while concentrating, it was reported, on such trivia as the design of a new brassiere for Jane Russell, star of the film.

When called to testify at Senate hearings on his company's wartime performance, Hughes admitted he had spent too much time completing the HFB-1. But "I put the sweat of my life into this thing," he said. ". . . if it [is] a failure I probably will leave this country and never come back, and I mean it."

At long last, a short flight

As soon as the hearings recessed, Hughes hurried back to California, determined to save his reputation. As one of his executives later wrote, he "applied himself to the [HFB-1] like a man possessed. Expense meant nothing. . . ."

On Saturday, November 1, 1947—four days before the Senate hearings were due to resume—time ran out. Hughes called the press to Long Beach Harbor, flooded the dry dock, and towed out the aircraft for all the world to see. Glistening in the sun like metal (it was painted with aluminum finish), the aircraft was a spectacular sight.

The next day, Hughes started the engines and made two taxi tests. Then he turned into the wind for one more run and pushed forward on the throttles. Bill Berry, a Hughes engineer standing behind him in the cockpit at that moment, describes what happened:

"When we reached about 65-70 miles per hour, Hughes asked . . . for 15-degree flaps. Those of us who were familiar with the flying boat knew it would lift off splendidly. And it did, right on the design

Presenting the Renault 18i.

It matches BMW 320i on the track, beats Toyota Celica at the gas pump, and offers comforts neither does.

Match BMW 320i on the track. Beat it by $4,000.

Imagine yourself on the test track.

You touch the accelerator of the bold new Renault 18i. Feel yourself pressed back into a form-fitting seat as you leap from 0 to 60 as swiftly as the BMW 320i.*

Now imagine paying a price $4,000 lower than the BMW's†. And getting front-wheel drive, standard. Bosch L-Jetronic fuel injection, standard. Road-hugging Michelin steel-belted radials, standard.

Beat Toyota Celica at the gas pump.

The same spirited engine that lets the Renault 18i match the quick BMW also lets it surpass the economical Toyota Celica's gas mileage.

37 HWY. EST. 26 EST. MPG.**

Enjoy comforts neither offers.

To feel the comforts of the new Renault 18i, start by sitting back.

Let leather seats cradle your body and support your back.

Open the front windows and lock the rear doors with just a finger's touch.†† Check the oil or disc brake wear without leaving the driver's seat. (The 320i and Celica don't even offer these comforts as options.)

The Renault 18i wagon: It drives like a sports sedan.

Finally, imagine a station wagon that accelerates and handles like a sports sedan and offers luxuries that even some luxury cars don't.

But you don't have to imagine the Renault 18i.

See it at more than 1,200 American Motors and Renault dealers.

Drive it.

Feel it.

We think you'll agree there's no other driving experience like it.

*Comparison of 1981 Renault 18i and 1980 BMW 320i.
†Based on P.O.E. manufacturers' suggested retail prices. Destination charges, state and local taxes, if any, and license fees extra.
**Compare these 1981 EPA estimates with estimated mpg for other cars. Your actual mileage depends on speed, trip length and weather. Actual highway mileage will probably be lower. California excluded.
††Optional equipment at extra cost.

Renault 18i

More than just economy

At Renault and American Motors dealers.

In November 1947, Hughes, at controls, prepares to taxi the 200-ton seaplane in Long Beach Harbor.

schedule. The noise of the airplane hull going over the chop of the water suddenly disappeared, and everything became quiet and smooth. We were airborne."

Spectators on the shore and in nearby boats were elated. The great wooden wonder, after five years of controversy, had flown under its own power. Hughes had demolished his critics' best argument.

Exercising an option in his contract, Hughes towed the aircraft back to its dry dock and leased the plane from the agency that had picked up the $18-million government tab, the Reconstruction Finance Corporation (RFC). Although his engineers continued to maintain the aircraft in immaculate condition, he would never move it again. It had saved Hughes' pride, the only purpose left for the plane by the time it was flyable.

By 1974, the Internal Revenue Service was threatening to disallow Hughes' deductions for maintaining the flying boat – which had cost him nearly $1 million a year. The General Services Administration, which by then owned the plane, and Summa, Hughes' holding company, worked out an agreement with the Smithsonian Institution: if unable to find a nonprofit organization qualified to display it intact, Summa would dismantle it and donate the pieces to various museums, including the Smithsonian.

News of the agreement provoked an immediate flap. Aviation buffs were outraged that the world's largest airplane might be destroyed. Summa (which gained title to the aircraft as a result of the agreement) said it would delay any drastic action as long as possible. Numerous promoters came forward during the next few years, but none could raise sufficient cash. At last, just as Summa was ready to dismantle the plane, Wrather Corporation, whose interests include the Disneyland Hotel and film production, negotiated a lease with the Port of Long Beach to take over operation of the *Queen Mary*. As part of the deal, Wrather said it would establish an aviation museum to house the flying boat.

It was an altogether fitting conclusion to the lengthy saga of the troubled aircraft. The company that owns such properties as *The Lone Ranger* and *Lassie* had, in true Hollywood style, saved the fair maiden from the buzzsaw.

Restless Hughes must be resting a little easier.

Airborne at last on its first and only flight, the airplane lifts off the waters of Long Beach Harbor on November 2, 1947. It rose 70 feet into the air, flew about a mile, set down for good and all.

More people enjoy V.O.'s taste than any other import.

That fact alone should solve your gift-giving problems.

V.O. is always welcomed. Because V.O. is preferred more than any other imported distilled spirit in America. More than any Scotch, Canadian, Rum, Gin, Vodka, Tequila. You name it. It's just a matter of taste.

Enjoy our quality in moderation.

CANADIAN WHISKY. A BLEND OF CANADA'S FINEST WHISKIES. 6 YEARS OLD. 86.8 PROOF. SEAGRAM DISTILLERS CO., N.Y.C.

These mining structures on a 5,000-acre site near Rifle, Colorado are visible evidence of the development of a new source of energy for America—shale oil.

Another Tenneco Venture:

Digging an "oil mine."

We're opening a whole new world of energy beneath the high country of western Colorado.

Locked underground in a thick layer of shale rock 1,500 feet beneath these tall towers are more than a billion barrels of recoverable oil.

Getting it out won't be easy. And it won't be cheap. It will take a capital investment of more than $2 billion—and there's no guarantee that this huge investment will pay off. It will require prices at least as high as today's imported oil for the project to be economically successful. But Tenneco, in partnership with Occidental Petroleum Corporation, is making a determined effort to unlock this new source of energy for America.

The shale rock must be heated to about 1,000°F before it will release its oil. Some competitive plans call for conventional mining of the shale and heating it in giant vessels on the surface. Our project involves the creation of huge combustion chambers underground.

About 25 percent of the shale rock will be mined. Carefully engineered explosions will break up the remaining shale into pieces of "rubblized" rock that fill chambers the size of 25-story buildings. These chambers will then be sealed and ignited at the top so that carbon contained in the rock will burn. As the flame descends (much as tobacco burns in a pipe—with air pumped in at the top and sucked out at the bottom) the heat releases the locked-in oil, which drains to the bottom and is piped off.

It will require the creation and operation of 100 of these underground chambers a year, plus processing the mined shale on the surface, to reach our goal of more than 60,000 barrels of oil a day by the late 1980's. At that point, it will be the largest underground mine in North America—and it should produce well into the next century.

But this is only the beginning. It is estimated that at least a trillion barrels of recoverable oil rest within the shale areas of Colorado, Utah and Wyoming—enough to keep America running for 150 years at present rates of oil consumption. A worthy national objective.

Although energy contributes more than two-thirds of Tenneco's income, we continue to provide other basic needs, like food, automotive components, farm and construction equipment, ships, packaging, chemicals, and insurance.

That's Tenneco today: growing in energy ... and more.

For more information about Tenneco, write to Tenneco Inc., Dept.S-5, Houston, TX 77001.

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AND THE SLEEPY

THE DAY BEGINS

HOURS OF NIGHT

ARE OVER

By Israel Shenker

A treasure awaits anyone who solves *Masquerade* riddle

Artist Kit Williams buried a golden hare somewhere in Britain, and legions of buyers of his clue-filled book are looking for it

Williams works meticulously on new painting at Horsley cottage. Paintings for book took three years.

Literature can be rewarding, but the payoff from a book called *Masquerade,* by Kit Williams, is something else again. Whoever solves the riddles it poses and the clues it conceals will know the location of buried treasure—real gold, really buried somewhere in the British Isles.

On the back dust jacket of *Masquerade,* photographed in pre-entombment splendor (p. 124), glints the treasure—a fretworked hare of 18-carat gold festooned with tinkling pendants and adorned with ruby, moonstone, turquoise, citrines, mother-of-pearl and faience. This treasure, the publisher maintains, "is as likely to be found by a bright child of ten with an understanding of language, simple mathematics and astronomy as it is to be found by an Oxford man." And, "it isn't necessary to go to the British Isles to locate the treasure." The clues in the book tell it all.

When the book came out in Britain in September 1979, it rose promptly to the top of best-seller lists (300,000 copies so far), transforming the life of its author-artist and afflicting the rest of the population with a sudden taste for pick and shovel. Now that the book has been published by Schocken Books in America as well, the depredations may reach new depths. Unless someone calls a halt—or finds the treasure—the green vales of Britain are in danger of being transformed into potholed wasteland, prey to the cupidity that dreams by day and digs by night.

Like the anagram RISE, Jack Hare is obvious in this painting, but can you find his friend the frog?

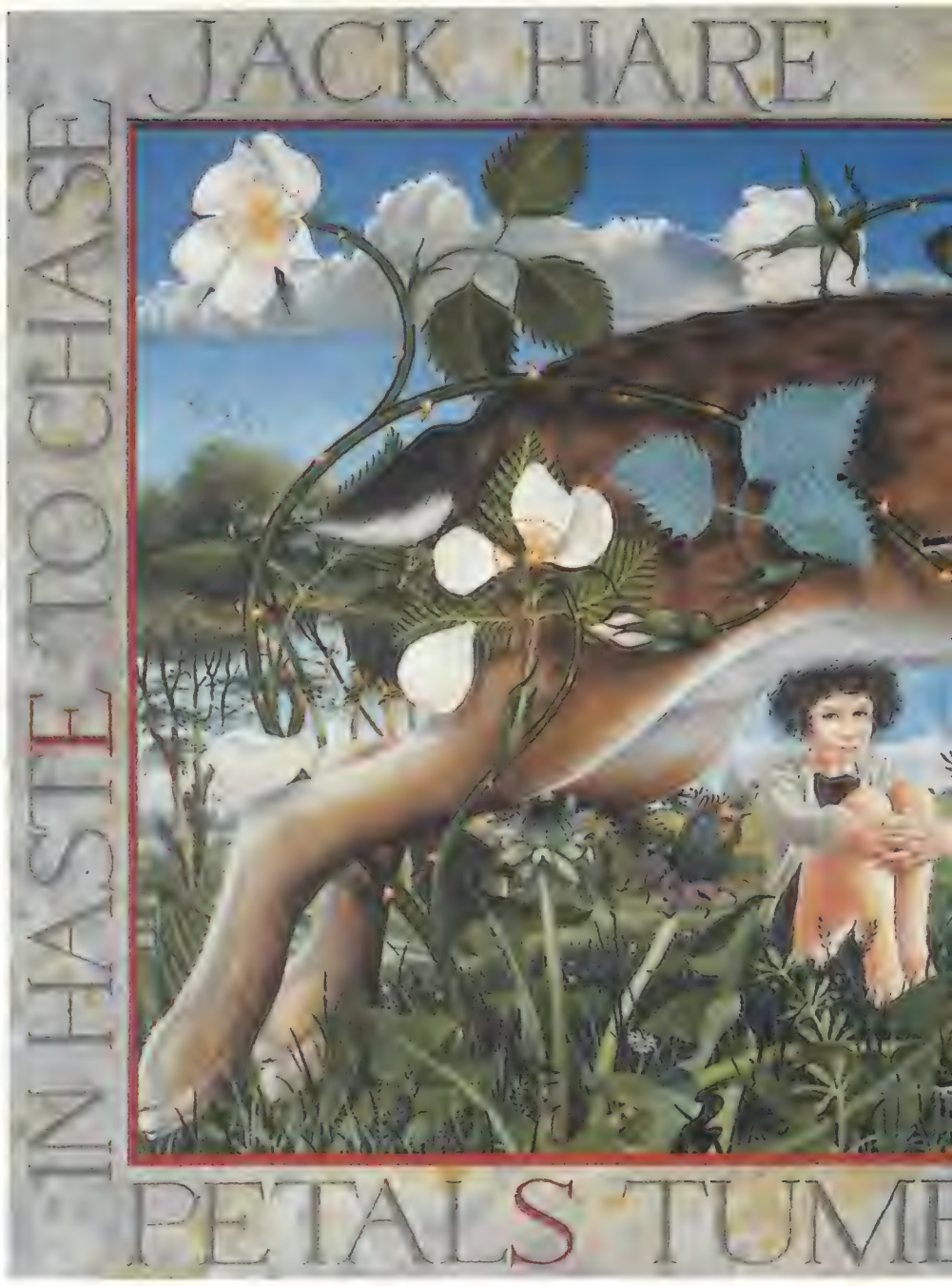
Superficially, *Masquerade* appears to be for children, with painted landscapes of magic realism—people and animals defying natural laws to loom large as houses, floating airily on high, coalescing into strange amalgams neither fish nor fowl—an enchanted dreamland part English village, part heavenly city. The words tell of Jack Hare's adventures through earth, air, fire and water as he seeks to bring a precious jewel from the moon to her beloved sun.

The fiend who distilled this moonshine is a deceptively amiable, curly-headed, red-bearded 34-year-old who walks like a man, dresses like a kaleidoscope and paints like a camera. Born in Kent, he says it was not till he was 11 years old—his accounts are tinged with an aura of fable, perhaps even blarney, he being half-Irish—that people realized "little Kit Williams could neither read nor write and was headed for diggin' and double diggin' and trench diggin' and double trench diggin'. I was what they now call dyslectic." At age 15 he managed to decipher a written appraisal by his English teacher: "I know he's alive because I've seen him breathing."

Oppressed by school and intrigued by romantic tales of life before the mast, Williams joined the navy and was sent to the Far East as an electronics repairman. Deciding that life intended him for better things, he announced that he was going to be a philos-

Paintings by Kit Williams

A treasure-hunter compares Sudbury Hall with building shown in book, but the fortune isn't here.



It is simple to get MOUSE out of the words that surround this painting, and the hare can't be

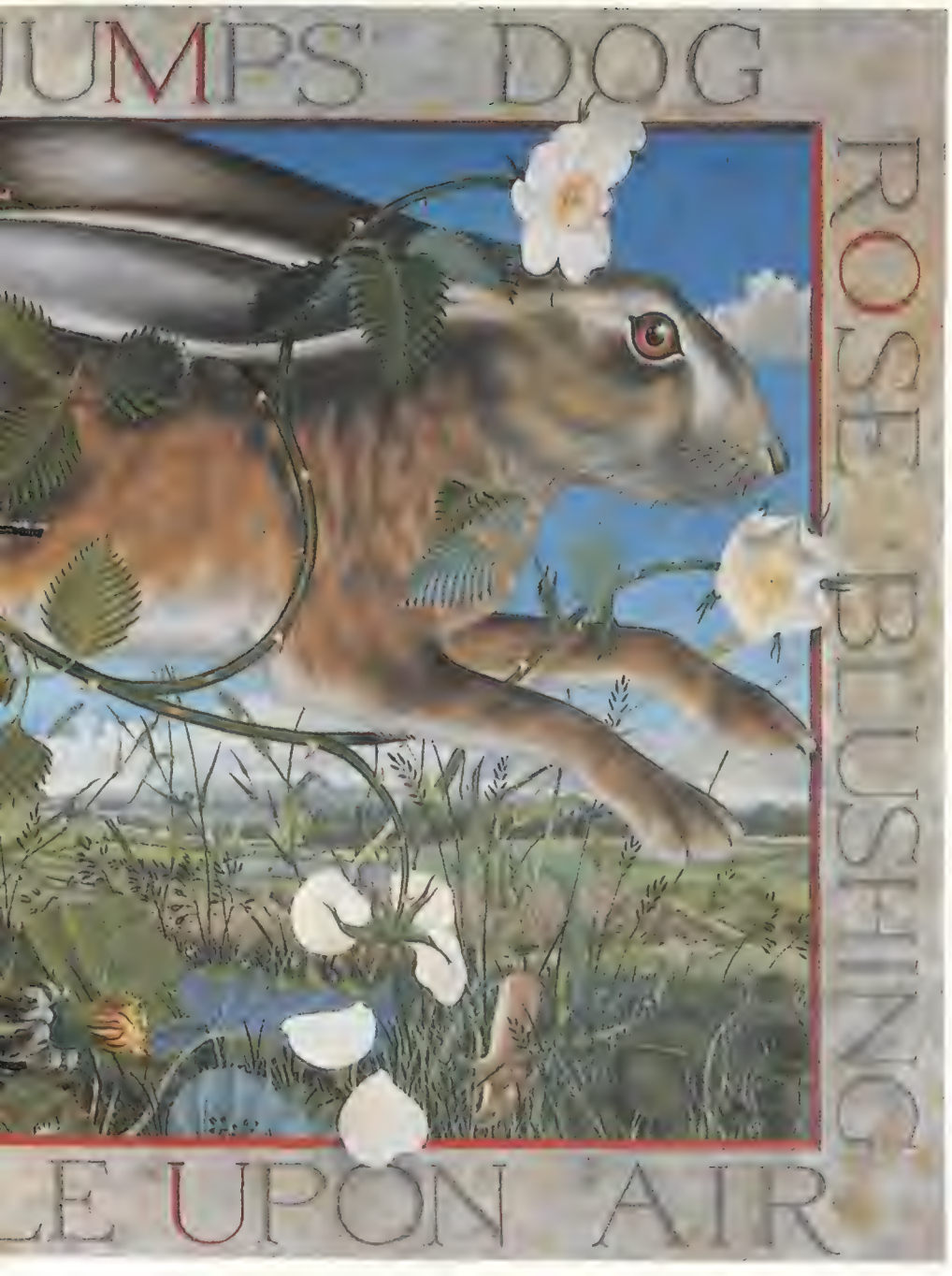
opher. From the ship's library he borrowed all three of its philosophy books—Bertrand Russell, Nietzsche and Marx—and four days later decided he was *not* going to be a philosopher. Eventually he realized that his true vocation was pacifism, and what he really wanted to be was a civilian.

Back in England he found work on navigational computer development for the Concorde. That took too much of what he called "thinking time," so he quit and turned to menial work, sweeping floors and erecting TV antennas. He married an art student and supported her while she studied. Then he took to the easel himself, without benefit of training, and a London gallery offered his works for sale. Tom Maschler, chairman of the publishing house of Jonathan Cape, was so impressed by one of the ingenious constructions —part painting, part Chinese puzzle—that he asked Williams to illustrate a children's book.

"I puffed myself to full size and said, 'I'm not an illustrator, I'm a painter,' " Williams recalled. " 'Painters don't get involved in books.' Then—I suppose he knew what he was doing—he said, 'Oh well, we thought you could do something no one else had done before.' "

That sentence did the trick; with his passion for doing the unusual, Williams felt he had to try. He unpuffed himself and calculated that the 16 to 20 paintings a children's book required would take him three years—36 months of boredom. Then, for the rest of his life he would be dogged by people asking what the paintings meant. If the book were nothing but symbols and puzzles and riddles, the questions would never end. "But if there was a big payoff they couldn't ask me questions, because it wouldn't be fair to the others," he reasoned.

"When I was a child and saw on the back of a cornflakes package some offer of treasure, it was never a



missed—but where does that get a mystified reader in the quest for the prize Williams hid?

real hidden treasure but just something involving boxtops and oozing commercialism. I was always frustrated because there was no real treasure. So I thought I'd do something for my lost childhood, and have a real buried treasure, real gold."

He began painting, wondering what the plot was, and slowly realizing that his book somehow would involve a messenger going through earth, air, fire and water—and that the messenger would be a hare. "I found the hare in all sorts of mythology," he said. "He's aloof, not cuddly like a rabbit but nocturnal, solitary, and he seems quite normal except in March when he goes a bit mad. You tend to see him at night, and if you see him then obviously the moon must be up." That brought the moon into the story, and it brought Williams out of his cottage to stare at the moon for hours, steeping himself in moonlight to capture its luminosity on canvas. Then a number of other characters began turning up, and they worried him. "Oh crumbs," he recalls saying to himself, "I hope I'll be able to tie this all together."

When he bought his modest cottage in Horsley, a hamlet in Gloucestershire, the house had no running water, electricity or sewerage, and there was no central heating, so he tried to keep warm by donning layer upon layer of clothing. As he painted, the heat from within the layers rose to the ceiling; there the vapor condensed and formed a drip that drummed down onto his head. So he pitched a plastic tent inside the room, and got inside with a kerosene stove. When his wife called him for meals he was increasingly reluctant to emerge, and as time went on he stayed there longer and longer each day, keeping his hunger at bay with music, tapping his feet to Irish tunes and painting through a film of tears as he listened to Mahler.

Onward crept the brush, millimeter by millimeter, obsessively filling space with minute detail. Over the sound of music the characters in his paintings began talking to him. "That's when I started to go mad," he said. "You don't explode into madness, and it isn't painful. You slip into it pleasantly." His wife left him, got a divorce and remarried.

Finally the characters in the paintings began letting him in on details of the plot of gold. He was very relieved, and he came out of the tent. It had taken three years to complete the 16 paintings and the master riddle; in less than three weeks he wrote the brief text and two weeks after that he had the title.

"The book is a big, fat, complex novel, but it's all in the pictures," he said, and suggested that the paintings were the text and the words the illustrations. "The words are the barest bones that can get you through the book. I thought, if the clues were in words, code breakers will solve it. If it was in numbers, computers will do it. If it was visual, no computer could do it and no code breaker could do it. So the essential element of the master riddle is in the drawings. You have to have all the pages—all the drawings —but you also need the words."

His final act of authorship was the treasure: "I knew if I went to the publisher and asked for the gold, he'd say, 'Oh, how much do you need? Don't you think you could do with less?' It had to be strong and beautiful and take your heart away."

He decided therefore to buy the gold himself. At that time a gold license was required. "Catch-22," he said. "In order to have a license you had to show you'd made things of gold, but in order to get the gold you had to have a license."

Though tempted by treasure-hunting, the author, now in Scotland, decided to stick to writing. He is a former Time *and* New York Times *staff member.*

Search for a tantalizing treasure

After polishing up some of his brass constructions, he sent photographs of them to the Bank of England. Not realizing that all that glisters is not gold, the bank rewarded his brass with a license.

"There were only two places I could buy the gold, a dealer in London and one in Birmingham," he said. "I wrote to Birmingham and told them how much gold I wanted, and they told me to phone up. I phoned up. They said I wanted the gold counter, and connected me. The gold counter said that her name was Dawn, and I should send her a signed, blank check, and she would fill in the sum according to the day's gold quotation, and send the gold."

Several days later the postman arrived at the cottage, bearing a heavy registered parcel and announcing, "This must have lead in it." "No," Williams remembers responding, "it's gold." The postman thought that was a joke. In honor of Dawn, Williams wrote her into his book: "Next, with a little gold taken from the dawn sky, she [the moon] cunningly wrought a splendrous jewel that was the perfect mirror of her love."

Never having made anything of gold, Williams went to the Victoria and Albert Museum and to the British Museum, and spent hours of staring time before gold artifacts, figuring out how they were made. When he applied his conclusions and completed the 5½-inch-long hare, together with satellites, he fashioned a hare-shaped, terra-cotta casket. His estimate of the treasure's value has ranged—depending on the day's gold quotation and his estimate of the value of his own labor—from $10,000 to $35,000.

The treasure had to be buried while someone of unquestioned probity witnessed the solemn act. "We thought of High Court judges and politicians," Williams said. "But nobody would believe them. So we decided we'd take somebody from television." His publisher suggested the television personality, historian and critic Bamber Gascoigne.

To prepare the ground, Williams borrowed a couple of dogs and went off with a large container of water. (It was a dry summer, and he wanted to wet the ground so that it would be easy to dig the hole: anyone who saw him spilling water would think it was to give the dogs a drink.) Then, in the early hours of the morning, with the moon full, and the treasure wrapped in paper and suspended in wax inside the casket, Gascoigne set off in his car, Williams trailing in his red van, and they drove to the anointed spot. As Williams dug, the moon hid behind clouds, and emerged when the deed was done.

"At first I thought the book would be solved within a week, but I had worked on it for three years and I was too close to it," Williams said. "It wasn't solved in the first week, and I thought, 'Oh, at least a few copies will be sold.' The first edition—50,000—sold out within one week. We rushed out another 50,000 copies, and they sold out. It knocked Frederick Forsyth out of first place on the best-seller list—plonk—just like that."

Red herrings and monofocal vision

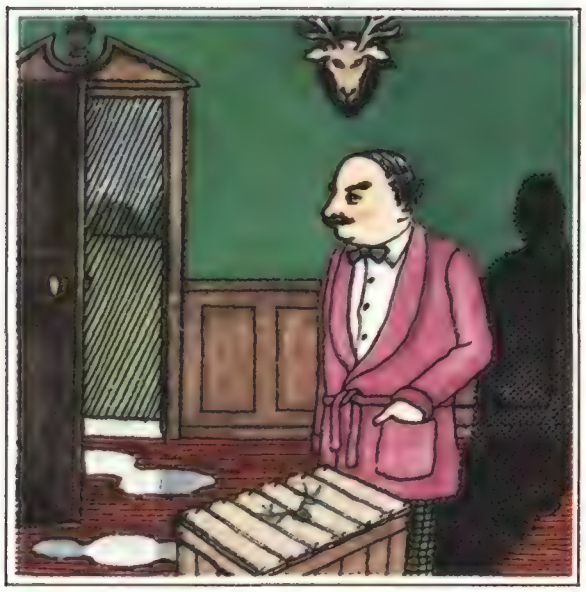
It knocked Williams right onto TV programs, where he cut a singular figure with his coats of many clashing colors and his tangle of tweeds, corduroys and denim, solids, stripes and checks. As he spoke he seemed to fix interviewers with one eye while looking at the camera with the other. "Monofocal vision," he explained. "Each eye sees separately and with no coordination, not a single image but two images, two channels that remain separate. I can look at a thing with one eye while using the other to paint what I see with that other eye. I've learned to use my disability very well, and I'd never have it straightened out."

Other things became equally clear, or unclear. The book had some red herrings, trails that led nowhere. There was a variant spelling in one painting—*Confectionary* instead of *Confectionery*. But that, say the dictionaries, is optional. From the start, some of the riddles were transparently simple:

> Fifty is my first,
> Nothing is my second,
> Five just makes my third,
> My fourth a vowel is reckoned,
>
> Now to find my name,
> Fit my parts together,
> I die if I get cold,
> But never fear cold weather.

An elementary knowledge of Roman numerals produced LOVE. From the printed border around the

THE CASE OF
·THE·
'AON BRAICH'



One rainy evening, a man with Gaelic on his breath delivered to my door a case of Glenfiddich. "Aon Braich," he murmured. No one here by that name, I mused. When I looked up, he had disappeared.

Upon cracking the cache of Glenfiddich with my Scottish Rites hatchet, I found each bottle of this distinctive malt whisky to be of triangular shape. Evidently, there were more sides to this story still.

Examining the label, I detected a most intriguing clue: Glenfiddich is Gaelic for 'Valley of the Deer.' Had this peculiar charade been nothing more than a cleverly staged stag party invitation?

A sudden revelation struck me like a belt from Savile Row. Perhaps the peat-stained pages of MacTurf's 'Scotch On The Lochs' would hold the explanation. I reached for my volume – but the book was gone!

It was then my friend MacIntosh rang. "Aon Braich!" he intoned. That strange name again! "I'd have returned the book myself, but with this downpour..." Then I saw my MacTurf tucked 'midst the malts.

A newly-marked page revealed that it was the Glenfiddich that was 'aon braich,' or single malt. One sip confirmed its singular character. Rarely had a case led me to such a splendid solution.

GLENFIDDICH® SINGLE MALT

Scotch Whisky

Glenfiddich Highland Unblended, Single Malt Scotch Whisky. 86 Proof. Bottled in Scotland. © William Grant & Sons, Inc., New York, N.Y. 10020.

painting of the fiddler who "plays the music that makes the world go round" it was easy to pick out a MELODY. And if the building was Sudbury Hall and the town Tewkesbury, that was getting places, but where did one go from there?

Soon the postman was wishing that he might go back to the job of carrying nothing heavier than lead, for his bag was filled daily with letters clamoring for hints, complaining of dead ends, cataloguing feats of derring-do as though only the brave deserved the hare, and asking point-blank if the treasure was buried "under the first sycamore tree just east of the Hog's Back Hotel on the main road from Farnham to Guildford."

From Shenfield, Essex, a treasure-hunter wrote that he had gone to the right place, but was surrounded by tourists and therefore unable to dig. "I believe the Golden Hare is hidden in Westminster Abbey beneath an iron grid between the North Wall and a Victorian brass of a knight and his family," he explained. "I cannot lift the grid without causing inconvenience to the staff of the Abbey and do not wish to do this without encouragement on your part."

As the hunt continued, foreign publishers joined the scramble, and the book came out in France and Germany, with editions scheduled as well in the Netherlands, Japan and Italy. Translation posed delicate problems, since the riddles, puzzles and anagrams depend on English.

As for Williams, all 16 of the paintings from *Masquerade* sold out within four days of going on show, and new works sell for upward of $10,000. "When I first knew about the money from the book I got grand," he said. "My accountant told me, 'You've got to buy a Porsche. You've got to live abroad to avoid taxes.' Then I saw a beautiful house, with an orchard, a stream running through the orchard, an old mill behind it, with a lake and woods. I thought, 'This is me. I'll sit on the veranda and I'll watch the gardener tending my garden.' But after a while my cottage said to me—this in plaintive tones—'Oh, you're not leaving me.' And I realized I don't need the beautiful house, I don't want to live abroad, I don't need the Porsche. I've got my little van, and it carries the firewood."

The weeds still grow high around the cottage, and insects, birds, snakes, toads, Willie the white cat and Kali the black cat luxuriate in this wilderness, giving Williams pleasure beyond words.

Inside the author's cottage, walls and furniture of riotous color and pattern lend witness to the mischief afoot there.

Williams lays down his canvas, picks up his shoes, and paints them green, to remind him of the green hills of home. He climbs the stairs, opens a tiny door, pushes a button to illuminate a minuscule stage set, and reassures himself that his seven toy mice are tucked into bed. Having provided a libretto of torment for readers, strains of guilt pursue him, but then he remembers that the treasure is real, is gold. There may be acorns on the tree depicted on the front jacket of *Masquerade,* but this book should not be judged by its cover; this is not a riddle in which great hoax out of little acorns grow. "Eventually it will be solved," he says. "I'd love to dig it up. That's the one thing I've denied myself."

This golden, bejeweled hare is the treasure, encased in a terra-cotta box, buried—and waiting to be found.

Can you spot Jack Hare in this AIR-y painting? You might just find him hidden in the shrubbery.

NOT AS HIGH

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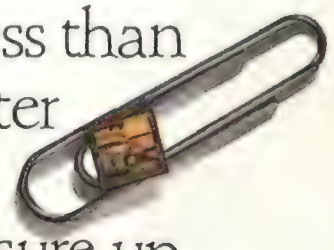

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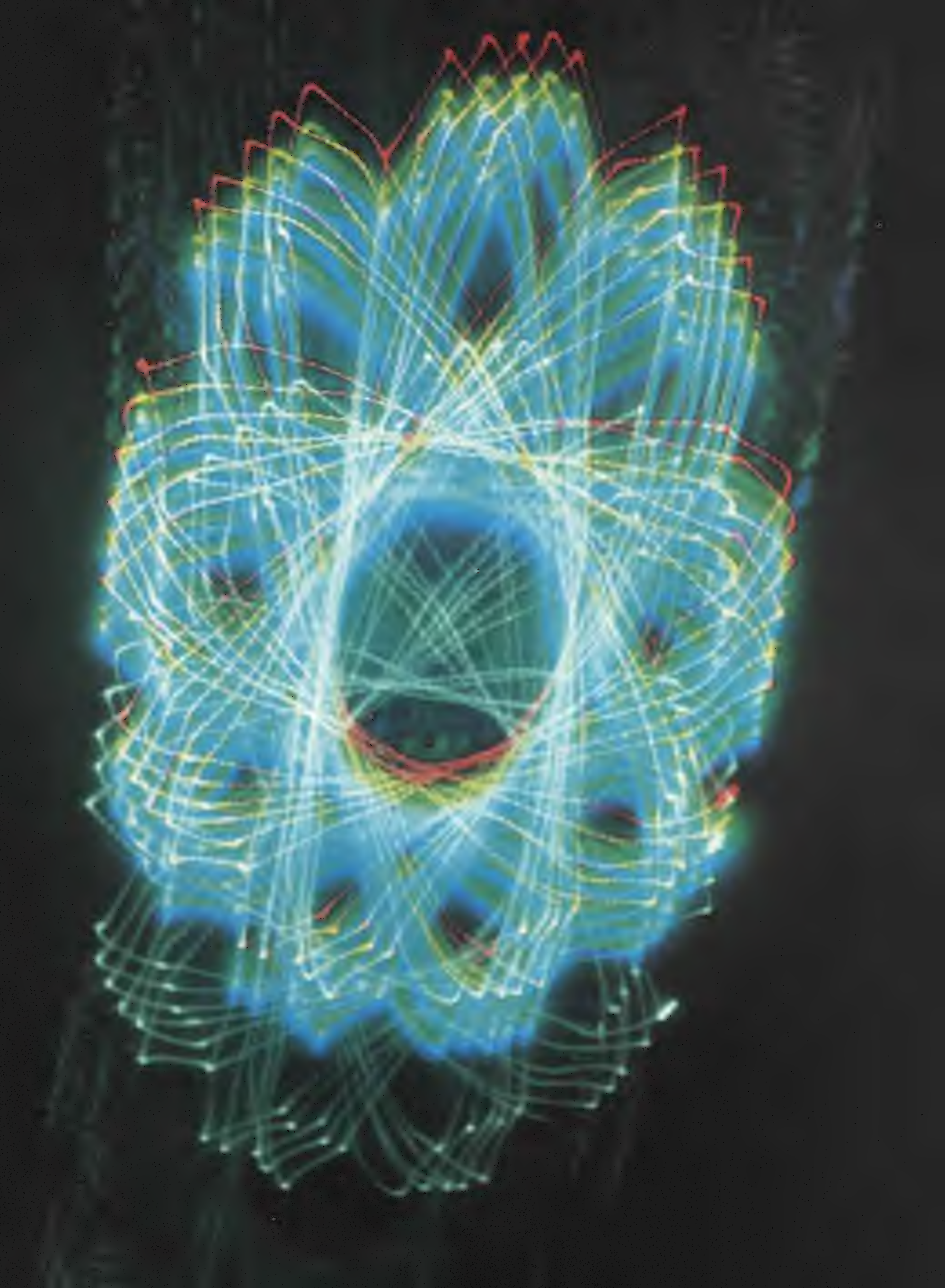


By Philip Boffey

An earthly furnace fueled by fusion nears a crucial test

The first 'break-even' reaction is in sight; even so, building a fusion reactor may be the Matterhorn of energy technologies

Back in 1951 President Juan Perón of Argentina startled the world with claims of a fantastic scientific advance. He announced that Argentina had found a simple, cheap way to produce atomic energy—through controlled nuclear fusion reactions like those that power the sun. The delighted dictator even pinned a medal on the inventor, an Austrian scientist who had moved to South America after World War II and become an Argentine citizen.

Few physicists elsewhere believed it was possible, but news reports of the supposed breakthrough did start a prominent American theoretical physicist, Lyman Spitzer jr., chairman of the astronomy department at Princeton University, thinking deeply about the potential for fusion energy. On a ski trip to Colorado, Spitzer used the long, lonely lift rides to think out a possible approach to controlling fusion reactions—and later gained government funding for research. So, too, did other American physicists who wanted to explore fusion energy concepts that had emerged from a military laboratory during the Second World War.

A few years later, it became clear that the Argentine claims were exaggerated. Argentina's fusion research center was shut down; the Austrian-born inventor was briefly jailed and was branded a fraud by a government committee. Jokes circulated that his only spectacular discovery was a new method for obtaining a national medal by bluff. But it would not be the last time that spectacular advances in fusion would be reported—only to evaporate on close inspection.

Almost three decades later, on a slow summer weekend in 1978, fusion again became a hot news story. Headlines described an experiment at Princeton—in the laboratory that grew out of Spitzer's work—as a "breakthrough" and a "major advance" toward "limitless electricity." For a few days it again seemed as if the energy crisis was about to be solved. But then the Department of Energy and the Princeton scientists held a press conference to explain that, while the results were "gratifying," they should not be termed a "breakthrough." Despite the scientific importance of Princeton's accomplishment, it is still true that practical fusion power will not be available for decades, if ever.

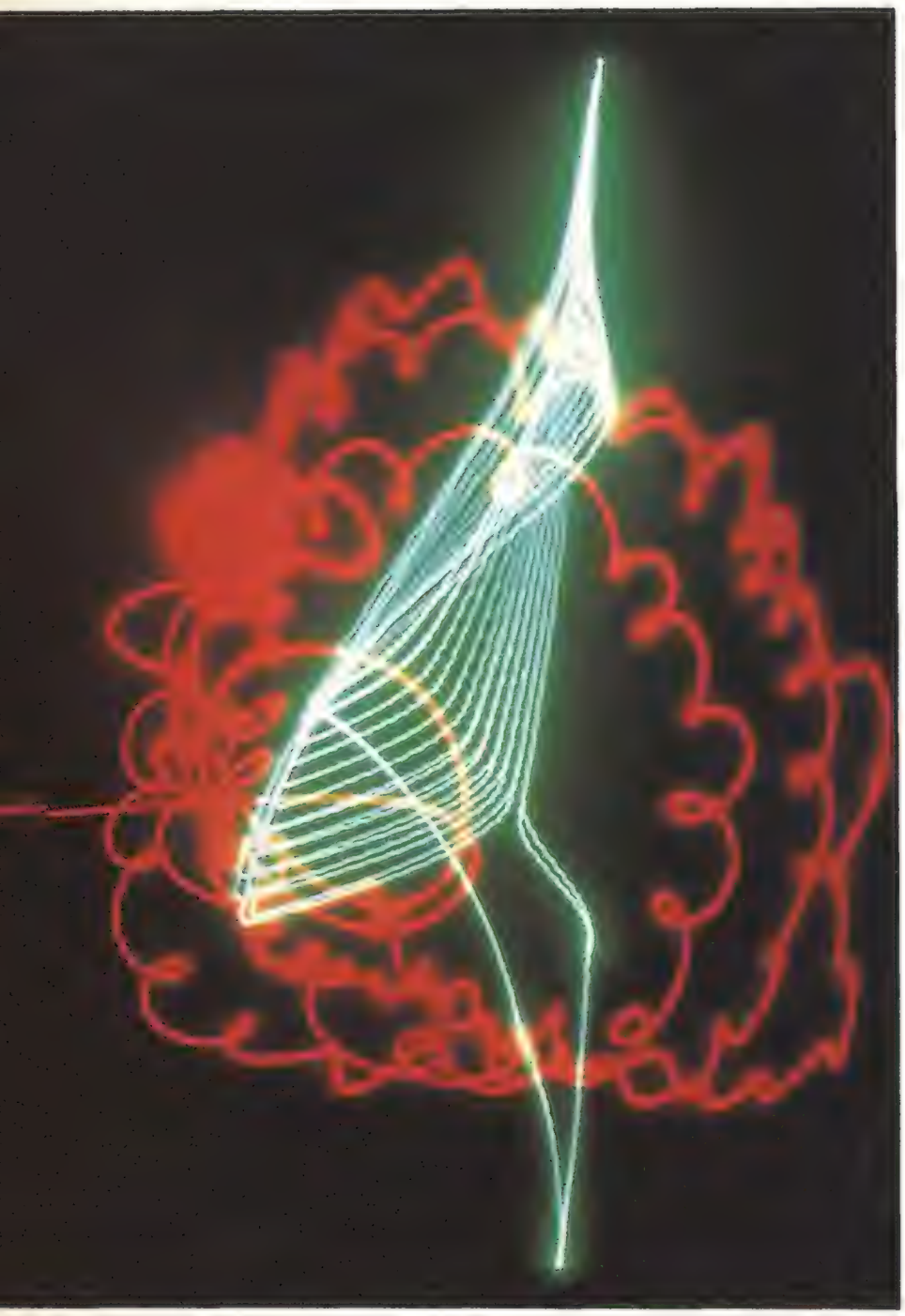
A single excited electron traces a cloud around a hydrogen atom. At extremely high temperatures, the electron will break away—a first step in fusion. This illustration and those on the following pages are laser drawings made at the Center for Advanced Visual Studies of the Massachusetts Institute of Technology. To make them, a computer translated the artists' visual schemes into rapidly changing points of laser light which were made into lines by motor-driven mirrors and then multiplied by other optical systems.

A glamorous source of energy

Even dollar-conscious politicians have sometimes urged crash programs to develop fusion reactors, analogous to the Manhattan project to build an atom bomb or the Apollo project to land men on the moon. This past summer the House of Representatives passed a bill urging a $20 billion effort to produce a fusion demonstration facility by 1987. Representative Mike McCormack (D-Wash.), the bill's chief sponsor, called fusion "the most important step in the history of mankind, as far as energy is concerned." The Senate toned the bill down, deleting the $20 billion figure and extending the target date for a magnetic fusion demonstration plant to around the year 2000. Congress did urge an acceleration of work on fusion engineering, and a doubling of funding over seven years. But the depth of the commitment to future boosts in funding is uncertain.

Fusion, the nuclear reaction that provides the sun's energy and the awesome blast of the hydrogen bomb, is undeniably glamorous. It could conceivably supply a large part of the world's energy needs virtually forever. It is no answer to the current oil crisis—it won't be available soon and it can't be put in the tank of a car—but eventually it could be used to replace the

Illustrations by Otto Piene, with Paul Earls, Elizabeth Goldring and Marc Palumbo



Holding superhot plasma in confined space requires intangible barriers; magnetic bottles are one idea. They are made of twisted magnetic fields which are generated by electric coils kept near absolute zero.

world's dwindling supplies of fossil fuels in generating electricity.

Enthusiasts almost always describe fusion as a potential dream source of energy—safe, clean, cheap and inexhaustible. Isaac Asimov, the noted science writer, describes it as "the great ark in which humanity can ride out the oil shortage that now threatens to overwhelm us." The Fusion Energy Foundation calls it "the gateway to a new world of abundance" in which there will be no technological obstacles to conquering poverty, hunger and disease. It is a seductive vision to a world running short of oil and gas, increasingly fearful of nuclear fission reactors, and loath to foul the air with pollution from burning coal.

Fusion is the opposite of fission, the reaction which powers existing nuclear plants. In fission, the nuclei of heavy atoms, such as uranium, are split, yielding smaller particles and substantial energy. In fusion, the nuclei of light atoms—hydrogen, for example—are made to unite, or fuse. As they do so, some of the original matter is converted into energy in accord with Einstein's famous law, $E=mc^2$.

Back in 1958 a prominent scientist was asked how long it would take to obtain practical electric power from fusion. "About 20 years," he replied. Six years later, he was asked the same question. "About 20 years," he replied again, smiling. Today the experts are still estimating at least 20 years. In fact, the glamorous energy source that seemed just around the corner has turned out to be the most difficult technological challenge ever undertaken by man.

One fusion expert "can almost feel it"

Experts differ on whether fusion will ever provide useful energy. "We really think it's almost in our hands," says Melvin Gottlieb, head of the research team at Princeton. "We can almost feel it." But Alvin Weinberg, a prominent nuclear physicist, considers fusion "an alternative that we cannot really count upon." And Edward Teller, chief inventor of the hydrogen bomb, a fusion weapon, adds: "Nobody knows. Certainly not those people who say they know. It could be very important. It could be not important at all."

The Princeton team may soon demonstrate that fusion is feasible scientifically—that it can produce more power than is required to bring about the reaction. But that crucial test will be just the first step toward useful energy. Engineers must then show that a practical power reactor can be built and be competitive economically with other power sources. Otherwise fusion may never be used.

The Department of Energy predicts that it will be well into the next century before a commercial fusion

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reactor is available. Even then, it will not be a panacea. As engineers have begun to focus on the practical problems of building fusion reactors, it is becoming clear that the energy they supply will be neither cheap, nor wholly safe or clean, nor truly inexhaustible.

The fission reaction is relatively easy to initiate because the nuclei of heavy atoms, such as uranium, are inherently unstable and hence easy to split. But the nuclei of light atoms do not readily fuse because they have positive electric charges that repel one another. They will fuse only if they are made to crash into each other at high speed—and that requires high temperatures to agitate the nuclei. On the sun, enormous gravitational forces squeeze matter together and raise temperatures at the core to 15 million degrees, enough to sustain a slow rate of fusion reactions. In the hydrogen bomb, the only successful fusion device so far on Earth, an ordinary atomic bomb is exploded to produce immense heat and pressure that then initiates a fusion reaction and causes an even greater thermonuclear blast. But it is hardly feasible to produce electricity by detonating atomic bombs or recreating the sun's gravitational field, so scientists have been struggling to achieve a controlled thermonuclear reaction on Earth.

The reaction can occur only under conditions that are extraordinarily difficult to achieve. In the most promising approach, a fuel made of the heavy isotopes of hydrogen (deuterium and tritium) would have to be heated to about 80 million degrees, five times hotter than the sun, and kept confined at one one-hundred-thousandth of the density of air for a full second. Scientists have been hoping to do this for the past quarter-century. Although they have achieved dramatic increases in temperature, density and confinement time in separate experiments, they have not yet even attempted the critical step of producing all three conditions together. "Had we known how difficult the task would be," says fusion expert Richard F. Post, "the fusion effort might have been prematurely abandoned."

Laser diagram of fusion shows the simplest form of the process: two protons colliding and giving off intense energy (positrons and gamma rays) as they fuse. Actual experiments are more complex, using deuterium.

A profound ignorance about plasmas

The most basic problem to overcome was a profound ignorance about the behavior of atomic particles at the tremendously high temperatures required for fusion. Once the temperature soars above 10,000 degrees, the electrons and nuclei separate to form a "plasma"—sometimes called a fourth state of matter—whose behavior differs from that of solids, liquids or gases. "It's as if you started studying a liquid and had never seen a liquid before," says Princeton's Gottlieb. A whole new field of plasma physics had to be developed. It has taken more than two decades to understand the baffling properties of these plasmas, let alone find some way to control them.

The job of holding the plasma in a confined space so that the particles are apt to collide has proved very difficult. If the plasma is allowed to strike its containment vessel's walls, it will cool so quickly it will revert back to a gas, disrupting the finicky fusion reactions. So scientists have been trying for years to erect intangible barriers.

The most popular approach is to use magnetic fields, twisted into complicated geometric patterns that keep the charged nuclei trapped in "magnetic bottles" of various sizes and shapes. This sounds simple in concept but in practice it has proved about as difficult as holding water in place by wrapping rubber bands around it. Even after decades of labor, all of the magnetic bottles leak in varying degrees. No matter how the magnetic fields are twisted and turned, there always seem to be openings through which some plasma can escape.

Turbulent instabilities in the plasma can also interfere with fusion. The U.S. government became so discouraged over this problem in the mid-1960s that it came close to halting all fusion work. Only after Soviet scientists showed that many instabilities could be suppressed by a new magnetic confinement device,

Philip Boffey is a science writer on the editorial board of the New York Times, *and former news writer for* Science. *He is author of* The Brain Bank of America.

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Plasma is the baffling fourth state of matter, which occurs when the nuclei and electrons of atoms fly apart at extreme temperatures, above 10,000 degrees. At much higher temperatures, nuclei begin to fuse.

called the tokamak, did the American program regain vigor. The highly touted Princeton results, achieved on an American version of the tokamak, seem to indicate that no more turbulence lies in the way of achieving a break-even fusion reaction, and Princeton scientists are now confident that they can do it as early as 1984.

Once that is done, an awesome technological and engineering challenge will remain—perhaps more difficult to surmount than the scientific problems already encountered. Fusion reactors will be complicated machines that must cope with extraordinary stress. In the tokamak reactor, as the deuterium and tritium nuclei begin to fuse, they will eject neutrons that whiz through the magnetic field and careen with great energy into a thick "blanket" of material surrounding the reactor core. This blanket must absorb the neutrons and convert their energy to heat that can power a conventional turbine to produce electricity. The blanket must also produce more fuel for the reactor. One of the isotopes used for fuel—tritium—occurs in nature only in minutest amounts. In fusion, it will be created when neutrons ejected from the plasma collide with lithium in the blanket.

Operating under unprecedented stress

Tokamaks will have to cope with an extraordinary temperature range. The plasma must be five times hotter than the sun while the magnetic field that contains it will be generated by superconducting magnets, only a few feet away, that operate at temperatures near absolute zero.

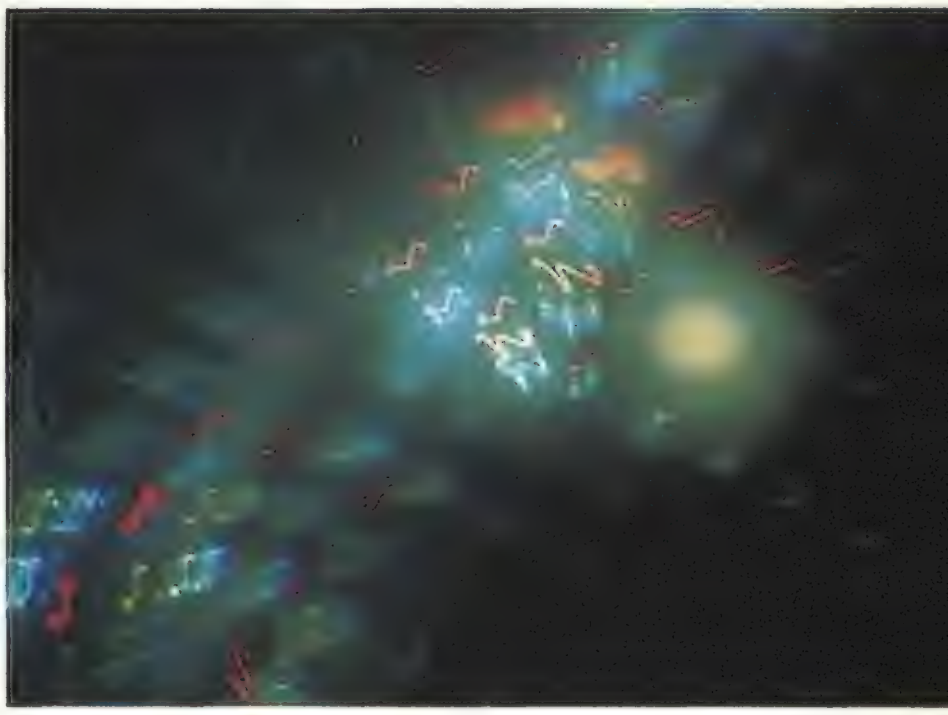
Reactor components will be subjected to such unprecedented stress that most may not last the lifetime of the plant. The inside wall of the blanket will absorb a ferocious bombardment of neutrons, radiation and heat. It may have to be replaced completely at least once during the life of the reactor—a difficult maintenance feat that will have to be performed by remote control because the wall will become radioactive. Scientists are seeking new materials and designs to extend the wall's life, but success is uncertain. The wall, says MIT nuclear engineer David J. Rose, "faces an environment that is unimaginably hostile—an energy flux that is higher than anything else ever made, except a nuclear weapon in the process of exploding."

The list of engineering problems seems endless. The plasma will have to be kept in a near-perfect vacuum to remain hot and pure; even minute leaks could let in material which would stop the reaction. The superconducting magnets will have to withstand enormous mechanical stresses for years. And techniques must still be perfected for heating the plasma, injecting fresh fuel, capturing the energy carried away from the plasma by neutrons, converting it to electricity, and recovering the fresh tritium fuel that is bred in the blanket.

Magnetic fields are not the only way to control a plasma; inertia can also be used. The fuel can be heated so rapidly—typically in less than a billionth of a second—that nuclei fuse before they have a chance to escape. That is what happens in the hydrogen bomb. And the same principle could theoretically be used to generate power. A tiny pellet of deuterium and tritium, 1/50th the size of a grain of rice, can be hit simultaneously from all sides by intense laser or particle beams, causing enough compression and heating to produce fusion. Inertial confinement research is lagging a few years behind magnetic fusion work and much less is known about what a practical reactor might look like. But, like a magnetic confinement reactor, it would face major stresses. In an inertial confinement reactor these would be caused by detonations equivalent to 100 pounds or more of high explosives inside the reactor, two or three times a second.

If a practical reactor is eventually developed, it will almost certainly not be an unmitigated blessing. Like all sources of energy, it will have advantages and disadvantages. Fusion should be superior in important respects to fission, but its virtues will be less than sometimes claimed.

Fusion's greatest advantage is an abundance of fuel. Fusion will not be literally inexhaustible. That exaggerated claim is based on the assumption that fusion reactors will eventually be fueled solely with deute-



Laser fusion is an alternative to the magnetic bottle, bombarding the deuterium with beams from all sides.

rium, which is so plentiful in seawater that supplies would last tens of billions of years at current rates of energy consumption. However, all of the fusion reactors now under development would also burn tritium, which must be created from lithium inside the reactor. There is enough lithium in the ground to last at least 1,000 years—and there is far more lithium in seawater, if an economical way can be found to extract it. Thus, while fusion based on deuterium-tritium is not as inexhaustible as solar energy, it would clearly provide energy for a very long time, far longer than oil has or coal will.

Fusion reactors would be safer than fission plants but would pose some dangers. They could not experience a runaway chain reaction that would cause core meltdown and large release of radioactivity, as was feared at Three Mile Island. If things went wrong, the fusion reaction would almost certainly quench itself. But safety analysts have concluded that some accidents are possible. The damage would be far less than in the worst fission accidents, but fusion can never be entirely free of risk.

Fusion reactors would cause fewer environmental problems than fission plants. They would not generate any radioactive materials as dangerous as plutonium, strontium or iodine, and their total radioactivity would be less. But they would not be altogether clean. They would burn and breed radioactive tritium, a substance that poses some hazard to humans and is difficult to contain; it can diffuse through stainless steel and most other metals useful in building a reactor. They would also generate large volumes of radioactive wastes in the form of wall and other components irradiated by the fierce neutron bombardment. Such wastes would be less long-lasting and easier to manage than fission wastes. They could conceivably be eliminated entirely through advanced fuel cycles and new structural materials. But the fusion community has only begun to address waste disposal.

A potential drawback to fusion is the risk of spreading nuclear weapons. Fusion reactors could conceivably be rigged to produce plutonium or uranium that could be used to make atomic bombs—but with such difficulty that fusion power is less worrisome than fission as a weapons source.

The chief disadvantage of fusion may well turn out to be cost. Projecting those costs now is a bit like asking the Wright brothers to estimate the cost of jet travel. But the early claims that fusion would be cheap were clearly exaggerated. The fuel for fusion should indeed be abundant and inexpensive. But the costs of building the technologically complex plants may be higher than it would be for building comparable fission plants.

If pure fusion proves unattainable, fusion advocates may fall back on fusion-fission hybrid reactors. These could use fusion and fission simultaneously to produce energy, or they could use fusion to produce energy and breed fission fuel for use in conventional reactors elsewhere. The sizable Russian fusion program is focused heavily on hybrids. From a safety and environmental standpoint, however, such reactors might be the most dangerous option. They contain the radioactive pollutants and the bomb-making materials found separately in pure fusion and fission reactors.

The hottest argument now raging over fusion concerns the pace and thrust of the government's research and development program. Fusion advocates want a more vigorous effort aimed at rapid construction of a demonstration plant and early commercialization. Skeptics fear such a crash program could result in choosing a poor design—probably the tokamak, which is closest to energy break-even but whose geometry is so complex that a working reactor might be cumbersome and costly. The Act passed by Congress this year seeks a compromise—a faster pace that will not preclude exploring several alternate approaches.

Professor Spitzer knew from the start it would be difficult. That's why he code-named his original research effort Project Matterhorn—to symbolize a difficult and challenging task. But even that name did not do the difficulties justice. The real Matterhorn proved easy to master. Dr. Spitzer and his wife soon thereafter climbed it, with the help of guides. But the energy peak he set out to conquer has yet to be scaled.

Inside a fusion reactor, in its "unimaginably hostile" environment, deuterium and tritium atoms fuse, ejecting neutrons that whiz through the magnetic field into surrounding lithium blanket—producing heat.

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By Nicholas Dean

John Paul Jones came awfully close to being a loser

The rascal-hero barely won fight with Serapis *before* Bonhomme Richard *(still unfound by searchers) was sunk*

Collection of Hugh S. Watson jr.

Idealized, probably posthumous, portrait shows Jones with cutlass at the ready, left hand on one of three pistols jammed into a wide sash at his waist.

Whitehaven, on the west coast of England, lay below us, half blotted out by a storm off the Irish Sea. As we rattled up the hill in Len English's ancient truck, he explained that "Red Flag House" (p. 142), where we were headed, had got its name from the signal flags ordered to be placed there after John Paul Jones' raid on the town in 1778. If the "pirate" had ever returned, the warning would have been visible far along the coast.

The house itself is gradually crumbling. The Half Moon Battery below it, whose guns Jones spiked, long ago fell into the sea. But the memory of Jones' exploits is still alive in these parts: the Paul Jones Tavern (p. 146) is the waterfront pub, and the bicentennial of the raid was duly celebrated with a reenactment, complete with souvenirs.

Still, the local people were puzzled as to why a Yank should be interested in Jones. "I thought Americans were only interested in Hadrian's Wall," said one. I explained that Jones was America's Nelson, that the battle between *Bonhomme Richard* and *Serapis* was part of our folklore, and that even as I was trying to get some picture of Jones, others were bobbing about in the North Sea on the other side of Britain, trying to locate the remains of his flagship. One man in the Globe Pub lifted his glass: "He's your hero, mate."

Hero, yes. But also a strange figure, so quick of temper that he would bang subordinates on the head to get his orders carried out; so arrogant that he would grab credit wherever any appeared, to the disgust of his fellow officers, and badger authorities for the sake of a decent command. Withal, he was sensitive, even poetic. And there was never a doubt of his bravery, though many of his battles and raids were so stricken with ill fortune and lack of discipline that they almost lapsed into farce.

John Paul, as he was born, was a local boy to these people. He came from Kirkbean, across Solway Firth in Scotland, and had gone to sea out of Whitehaven. When he returned to capture and burn shipping, his former friends and neighbors were, to put it mildly, outraged. "A great villain," sneered the Countess of Selkirk. Even today, the guidebook I bought calls him a "swaggering pirate."

I had gone first to the cottage where he was born, at Arbigland, which, in 1747, was William Craik's estate just south of Kirkbean on the shore of the Firth. As I walked from the village I retraced the route young John would have taken going home from school, through delightful fields full of rabbits and magpies, yellow gorse and Scots bluebells, and always, over all, the blue hump of Criffel, the local mountain.

John Paul's father, an irascible Scot, was gardener to William Craik. His son's career began with an apprenticeship on a Whitehaven brig. By the age of 21 he had a command. He was a short, husky young man with deep-set eyes and aquiline nose, not handsome but attractive to

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Jones was born in this comfortable gardener's cottage on the estate of William Craik, Kirkbean, "easternmost parish of the Lordship of Galloway."

women, softspoken, yet with his father's blazing temper. It was the temper that got him into trouble on an early voyage, when he had his carpenter flogged. The man died later, and when Paul arrived back in Kirkcudbright, home port of his vessel, he was clapped in jail.

Young Paul managed to raise bail, then sailed back to the West Indies and cleared himself. By the end of 1772, Paul was captain and possibly part owner of *Betsy* of London, engaged in the West Indies trade. On his second voyage in her she began to leak and Captain Paul had to take her into Cork. There he came down with a fever and not until early summer did *Betsy* finally set sail for Tobago.

For six months *Betsy* had been eating up money while not carrying cargo. When she arrived in Tobago, Captain Paul decided to use his dwindling cash to pick up a cargo, return to England and then pay off the crew. That was a mistake. Many of the crew were Tobagans and they had been looking forward to a good time ashore.

And so, on a sweltering afternoon, Paul faced mutiny that altered his name and his life. The brutish ringleader led the crew in a rush, forcing Paul to the edge of an open hatch. The captain then raised his sword and the seaman was impaled. Evidently warned that he would surely be railroaded on a murder charge, Captain Paul simply vanished. He reappeared 20 months later in Philadelphia as John Paul Jones and got a commission in the American Continental Navy.

Jones lost valuable seniority by declining the first two commands he was offered and became First Lieutenant on *Alfred* under Dudley Saltonstall, who later proved himself incompetent. In August 1776 Jones became a captain. Also in 1776, Jones commanded *Providence* and *Alfred* in two successful cruises. In June 1777, after many failed hopes and much lobbying, Jones was given command of *Ranger*, a new sloop of war, then fitting out in Portsmouth, New Hampshire. He was to take *Ranger* to France, where he was promised a new command.

The Congressional resolution read, "*Resolved*, that Captain John Paul Jones be appointed to command the said ship *Ranger*," and was published on the same day as the official announcement of the form of the American flag. Jones received his orders and headed for Portsmouth.

While in Portsmouth Jones found time to correspond with the black poet Phyllis Wheatley, whom he had met in Boston,

Nicholas Dean, free-lance writer and photographer, spent a month at scenes of Jones' exploits. He lives in Maine.

He created some of the world's most passionate music.

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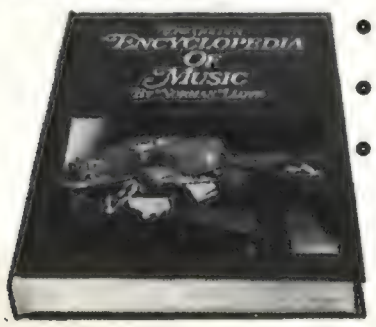

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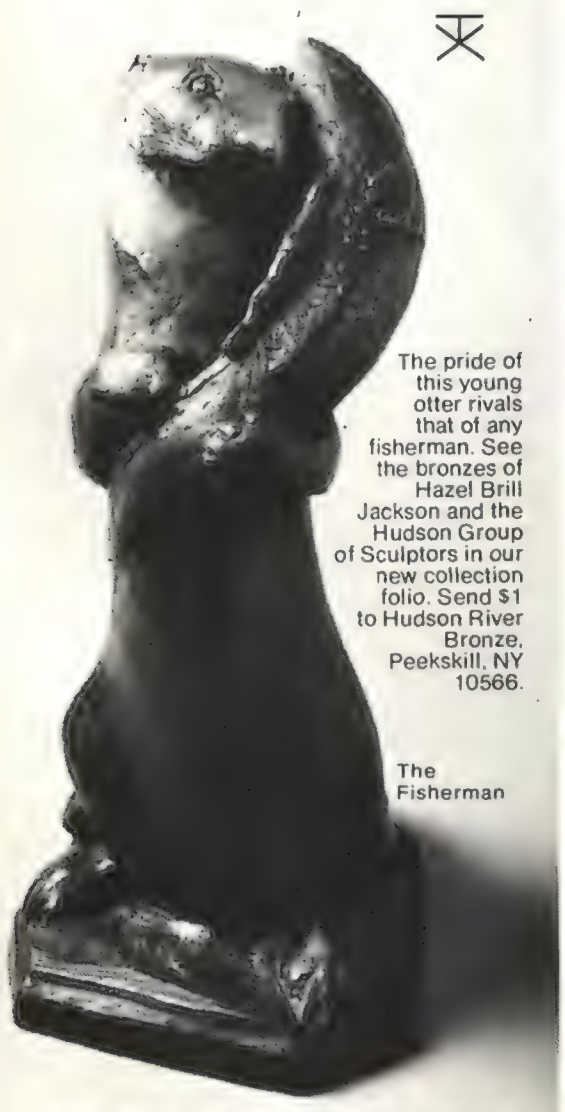

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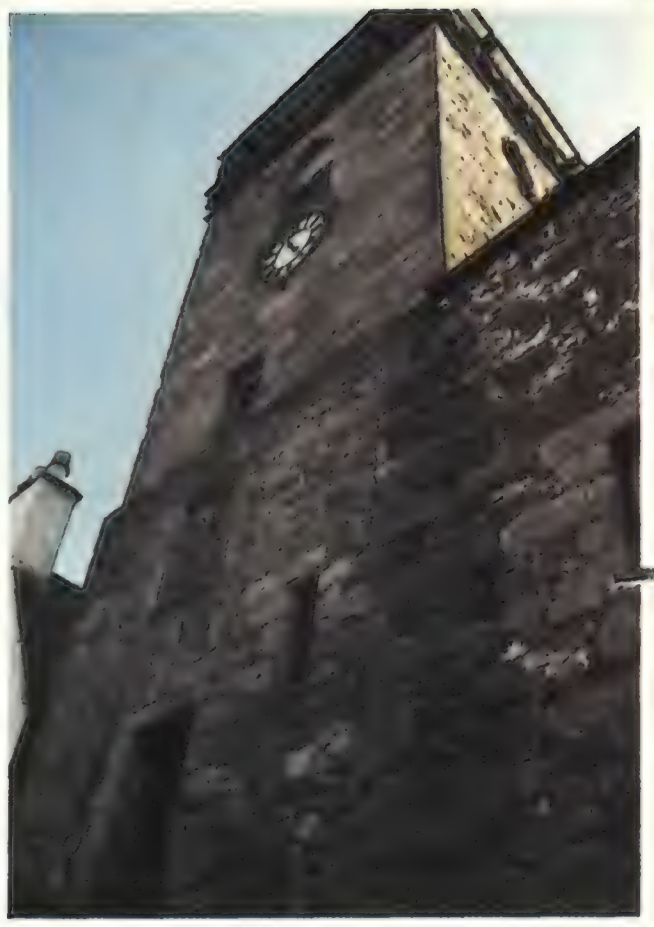
sending her some of his own verse. The same captain who could kick a midshipman "on the breach several times" could make poetic allusions in his reports. John Adams probably described him best when he said: "Eccentricities and Irregularities are to be expected from him—they are in his Character, they are visible in his Eyes. His voice is soft and still and small, his eye has keenness and Wildness and softness in it."

Although *Ranger* was evidently a trim ship of about 110 feet, Jones found much to be desired concerning her rig and ordered a number of alterations as soon as he arrived in France. The real problem was manning her. With one exception *Ranger*'s officers were all local men. New England seamen do not take kindly to outsiders, and Jones was not even American. To make matters worse, privateers paid better than the young navy.

Ranger's recruiting posters called her "one of the best Cruizers in America" and solicited "Gentlemen volunteers who have a Mind to take an agreeable Voyage in the pleasant Season of the year." It also mentions something about making "their fortune." Her crew would later remind Jones of that promise. On November 1, *Ranger* sailed for France with a complement of about 150 officers and men. The passage took 31 days.

Jones expected to be assigned the frigate *L'Indien,* then under construction in Holland. Unfortunately, Congress,



Jones was once jailed here in Tolbooth (prison) at Kirkcudbright.

At the "Red Flag House," Len English stops by to feed horses he keeps there.

short of money and having trouble with the Dutch, sold her to France. Jones went to consult Commissioners Benjamin Franklin, Arthur Lee and Silas Deane.

They lived outside Paris on the estate of Jacques Donatien Le Ray de Chaumont, a prosperous merchant trader who had negotiated much unofficial French aid to the Americans. Jones immediately struck up a friendship with Franklin, thus alienating Lee, Franklin's rival. And de Chaumont's wife, Thérèse, several years younger than her husband, became Jones' mistress. Since he often had to deal with her husband on business, it must have been interesting.

Frustrated over *L'Indien,* Jones returned to the Loire port of Paimboeuf and found *Ranger*'s crew homesick, sullenly waiting for prize money from the captured vessels. The commissioners had ordered Jones to proceed "in the manner you shall judge best for distressing the Enemies of the United States, by sea or otherwise. . . ." Jones interpreted this as the go-ahead for a shore raid on England itself, but his crew saw that scheme as a great risk for no possible prize money. The commissioners had promised to ask Congress for a bonus for a raid, but there was no word yet.

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After several short cruises, Jones set out again on April 10 and took his first prize April 14. He sank her, probably because she was of slight value and he did not wish to reduce his crew, which had suffered desertions. On April 18, off the Isle of Man, he was ready to cross to Whitehaven for the long-planned shore raid, but *Ranger* brushed with the revenue cutter *Hussar*. The British escaped by clever maneuvering. Still no prizes.

At last the crew of a captured fishing boat told them that HMS *Drake* lay at anchor in Belfast Lough on the Irish coast. Jones wanted to go in after her on the spot, but his crew refused. He persuaded them to try a night attack, to slip in, anchor upwind, rake *Drake* with gunfire and board her. *Ranger* entered the harbor after dark disguised as a merchantman, and at the critical moment, Jones gave the order, "Let go!" The quartermaster fumbled in drunken incompetence. The anchor caught on the cathead and by the time the anchor detail freed it *Ranger* was out of position. Jones ordered the cable cut and tacked out, intending to try again the following night. But the wind came on in a gale, and *Ranger* had to run for Scotland's lee.

The gale persisted, blowing sleet and snow in heavy seas, but by the night of the 21st, with the weather letting up, Jones announced they would try the Whitehaven raid in the morning. His wet and dispirited crew did not share his enthusiasm. His surgeon remarked that there was no point in "burning poor people's houses" (although that was precisely what the British had been doing in New England). One of the sailors told a Swedish volunteer, Lieutenant Meijer, that there was mutiny afoot, and Meijer told Jones. When the sailing master, Cullam, rushed Jones, Jones placed a pistol at his temple. The mutiny, he announced, was over. The raid on Whitehaven was on.

Watchtower at Whitehaven, where Jones' raiders fired ship in harbor.

Although *Ranger*'s lieutenants begged off, pleading fatigue, Jones assembled about 40 volunteers. At midnight the boats pushed off, Jones with Meijer his second-in-command, Lieutenant Wallingford of the Marines and Midshipman Ben Hill in the other. It was cold and clear. The storm had left "the three kingdoms [England, Scotland and the Isle of Man] as far as the eye could reach, covered with snow." It was a long pull to shore against the tide and it was about 3 A.M. when they approached the town. Whitehaven lay in shadow against the hills. Ahead of them loomed the silhouette of the Old Quay, which separated the two halves of the harbor, with a wink of light to mark Allison's Pub. To starboard in the darkness lay a sandy spit of land, a perfect landing place, and beyond that, above a cobble beach, the Half Moon Battery, which Jones' party was to silence. The others were to go to the harbor and burn what ships they could.

While Meijer guarded the boat, Jones and a few men scaled the walls of the battery, climbing on each other's shoulders. They locked up the sleeping guards and spiked the guns of the north battery.

By now an Irish seaman, who had enlisted only to get home, had roused the town and people were gathering in the dawn light. Jones managed to set fire to the collier *Thompson* before returning to the *Ranger*. Little damage had been done —perhaps as much as £1,250—but the emotional impact was tremendous. Seacoast towns began clamoring for Royal Navy protection, just what Jones wanted.

He now headed *Ranger* northwest across Solway Firth toward Kirkcudbright. Jones planned to kidnap the Earl of Selkirk and hold him as ransom for American seamen held in British prisons.

St. Mary's Isle, seat of the Earls of Selkirk, is really a peninsula which juts into Kirkcudbright Bay below the town. Jones ordered *Ranger* to stand off southwest of the Isle while he got a raiding party ready. He, with Cullam the sailing master (presumably forgiven for his previous mutiny) and Lieutenant Wallingford would go ashore with the seamen.

When the raiders marched from the cutter to the house, they encountered the gardener, and led him to think they were an impressment gang, a ruse that led to the other, younger servants vanishing. The gardener, however, had bad news.

Lady Selkirk's teapot, seized by Jones' men, later was returned by him.

A gun commanding Whitehaven harbor may date from time of Jones' raid.

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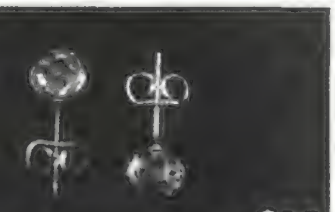
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Patrons of the Paul Jones Tavern at Whitehaven hoisted glasses last year to help celebrate the bicentennial of Jones' raid there.

The Earl was not at home, gone, he said, "to take the waters" in Derbyshire, leaving behind Lady Selkirk.

Disappointed, Jones headed back to the cutter. He was stopped by his crew, who saw a chance of booty. "Some Officers who were with me," he wrote, "could not forbear expressing their discontent; observing that in America no delicacy was shown by the English, who took away all sorts of movable property. . . ." Jones reluctantly agreed that his men might go to the house but—and he emphasized this—the seamen were to remain outside. He would wait at the cutter.

Lady Selkirk, with her butler and the governess, met the Americans at the door. The two officers entered. Wallingford, she wrote the Earl, "seemed naturally well bred and not to like his employment"; Cullam "had a vile, blackguard look." They announced that they had come for the plate, and that if she produced it there would be no search. While the governess, Mrs. Elliott, chatted with the sailors lounging outside (who, she reported, "behaved with great civility"), the Countess ordered Daniel, the butler, to get the silver and bags in which to put it. Daniel, who had been trying to hide some of it, started packing.

As the bags filled, Cullam brusquely demanded to see an inventory. As he glanced at it, he noticed that the teapot and coffee pot were missing, and these were brought from their hiding place, the teapot still full of tea leaves from breakfast. Wallingford seemed embarrassed. He began to write out a receipt for the silver, but Cullam cut him short. The Countess, ever the lady, offered the officers a glass of wine.

The raiders returned to *Ranger*. As she departed, a few brave local men dragged a cannon to the southern tip of the Isle and fired at a silhouetted rock which they took to be her hull. Others rode to light alarm fires. The Countess indignantly informed William Craik that his late gardener's son, "born in your grounds," had returned as a buccaneer and she wrote the Earl that the "great villain" had taken the silver.

Jones, too, was embarrassed by the raid. Kidnapping the Earl was one thing, an act of war. Robbing the Countess was

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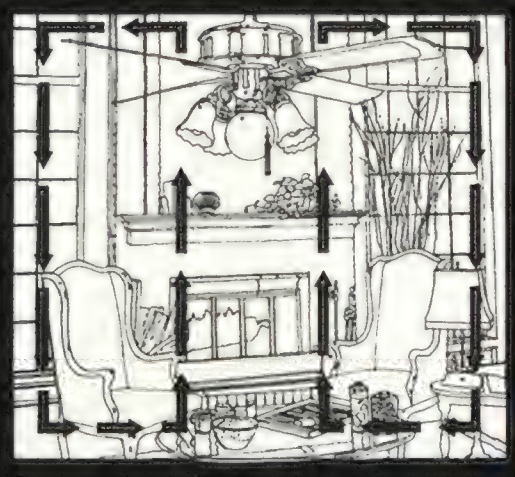

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more than he had intended. When *Ranger* returned to Brest he wrote her: "when the plate is sold, I shall become the Purchaser, and I will gratify *my own feelings* by restoring it to you, by such conveyance as you shall be pleased to direct." It cost Jones more than $500 to keep his promise, and when the teapot was returned in 1783, the tea leaves were still inside.

Jones lay in wait for HMS *Drake* at the mouth of Belfast Lough. As *Ranger* waited, the crew was again on the verge of mutiny, led by Lieutenant Simpson. But the capture of one of *Drake*'s boats "tickled the caprice" of the crew and they decided to fight after all.

Drake came out against a brisk northeast wind. An hour before sunset a bloody battle began. Sharpshooters killed the British captain and mortally wounded his second in command. *Drake*'s sailing master finally called for quarter.

Back in Brest, Jones surrendered command of *Ranger,* probably with a mixture of relief at being rid of his quarrelsome crew and hope of at last getting command of *L'Indien,* which by now was almost finished. Franklin was reassuring but nothing happened. Jones remained at Brest, fearing to miss any action that might materialize. He grew increasingly irritable as each hope of a command came and went.

Route of *Ranger* is in blue; *Richard* (red) sailed far to meet her fate.

"I intend to go in harm's way"

Jones had a clear idea of what his new ship should be like if he could not get *L'Indien.* "I wish to have no Connection with any Ship that does not sail *fast;* for I intend to go *in harm's way.*" After months of frustration, he finally settled (in February 1779) for an elderly East Indiaman, *Le Duc de Duras.* Complimenting Franklin, he renamed her *Le Bonhomme Richard.*

She was probably about 145 feet in length, carrying 40 guns. Jones had gunports pierced for six 18-pounders.

On June 19, Jones put to sea on a shakedown cruise escorting French merchant vessels to various ports. His squadron included the lightly armed *Vengeance* and *Le Cerf,* the 32-gun *Pallas* and the new American frigate *Alliance,* under the French captain Pierre Landais. Jones discovered two problems: *Richard*'s sailing qualities, or lack of them, and Landais.

Landais claimed, by virtue of his honorary Massachusetts citizenship, that he was the only "genuine" American commander in the squadron, and he resented taking orders from Jones. He was unstable. (John Adams called him "an embarrassed Mind.") The first night out, with *Richard* and *Alliance* on a collision course, Landais went below to "load his pistols." The crash carried away *Richard*'s bowsprit and *Alliance*'s mizzen, and although *Richard*'s deck officer was court-martialed, the feeling was that Landais could have avoided the collision.

When Jones put back to Lorient for repairs, he enlisted several Americans recently exchanged from British prisons. Among them was Midshipman Nathaniel Fanning of Connecticut, who would later write a lively view of *Richard*'s last cruise. Jones was sick for the first time in years, and an uneasy truce between him and his subordinates began to fall apart. The *Richard*'s most famous cruise got off to an inauspicious start August 14, 1779.

Off Ireland, *Richard* was becalmed. The crew of the boat assigned to tow her cast loose and headed for shore, vainly pursued by the sailing master. Landais stormed aboard *Richard,* accused Jones of bungling, and in "the most gross and insulting terms," and then told him that henceforth he, Pierre Landais, would do

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as he chose and then took off in *Alliance.*

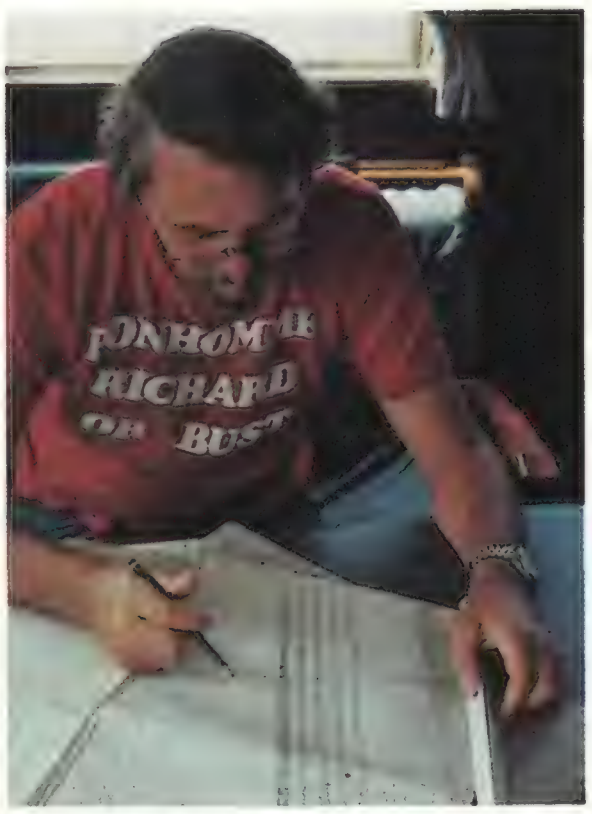
The squadron headed north, around Scotland, in dirty weather. On September 13, as the fleet headed south, the weather broke enough to give them a sight of the hills above Dunbar, on the east coast of Scotland. Jones gathered his remaining captains aboard *Richard* and together they formed a daring plan: they would sail up the Firth of Forth and hold the City of Leith for £200,000 ransom!

Meanwhile, however, *Pallas* and *Vengeance,* in the absence of their captains, had gone looking for prizes to the southward. The lure of prize money, which in those days supplemented the meager regular pay, was stronger inducement than tactical considerations.

The city was in turmoil as Jones brought his fleet toward Leith. At Kirkaldy, on the north shore, the parson, Mr. Shirra, moved to the water's edge and asked the "Laird" to "blaw the scoundrel out of our gate." By the time Jones was ready to embark a landing party, a "Very severe gale of wind came on." One of Jones' prizes sank, one was ransomed, and the other ships returned to the mouth of the Firth. Leith was saved and Mr. Shirra got the credit.

Dawn on September 23 found *Richard* just south of Flamborough Head, near Bridlington. Landais had reappeared.

There was a kind of heroic inevitability



Clive (*Raise the Titanic!*) Cussler will keep trying to locate the *Richard.*

Cockermouth Grammar School

Captain Richard Pearson, RN, who commanded *Serapis* in epic battle.

about the events of that day, 201 years ago. Had a balloon floated high above Bridlington, the pilot would have seen, coming from the north, the Baltic Convoy, carrying essential supplies for the Royal Navy and escorted by two warships, *Countess of Scarborough* and the new *Serapis,* just six months old, commanded by Captain Richard Pearson. From the south, Jones' squadron ghosted toward Flamborough Head, carried as much by the tide as by a faint breeze.

Pearson's lookouts spotted Jones' mastheads about 1 P.M. A boat from shore had warned the British captain that the raiders were nearby, and he decided to interpose his warships to give the slower merchantmen a chance to get away.

Jones did not spot the British until 3 P.M., when 41 sail appeared off the Head. He hoisted the signal "General chase" and, later, "Form line of battle," but his fellow captains fell back or drifted away. So *Richard,* the ship Jones hadn't wanted, manned by a crew he had gathered as best he could, drifted toward *Serapis.* The two ships closed.

Ashore, people of East Yorkshire crowded vantage points to watch as *Serapis* and *Richard* approached each other, silhouetted against the yellow September moon. Pearson hailed *Richard.* "What ship is

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"I have not yet begun to fight!" Jones trumpets from the splintered *Bonhomme Richard* in response to *Serapis'* query if he were giving up.

that?" Jones muttered an evasive answer.

"Answer immediately," shouted Pearson, "or I shall be under the necessity of firing into you!"

The two dark rows of *Serapis'* gunports drew closer. Jones dropped the British colors and ran up the Stars and Stripes. "We answered him by firing a whole broadside," Jones recalled. *Serapis* fired almost simultaneously. People ashore saw red flashes followed by a roar, which soon became continuous.

The two captains maneuvered their ships in the near calm like elephants in a ballet. Very early, two of Jones' 18-pounders blew up, killing their crews. *Serapis* began to make matchwood out of *Richard's* hull. Eventually, *Serapis'* bowsprit caught *Richard's* shrouds. *Richard* pivoted on *Serapis'* bow and the two ships swung together, bow to stern. Pearson ordered *Serapis'* anchor let go, hoping *Richard* would drift away, but Jones had already grappled. With his own hands he had made fast a dangling line from *Serapis*. "Well done, my brave lads, we have got her now!"

The two ships lay so close that *Serapis'* guns could not be run out. The incessant fire from *Serapis* silenced *Richard's* starboard 12-pounders. Jones helped move a nine-pounder over from the port side. British guns blasted such holes in *Richard* that shot had virtually nothing left to hit. Jones was down to three guns. He kept them trained on *Serapis'* masts.

In the midst of all this, Landais appeared in *Alliance*. Instead of firing at *Serapis*, he raked *Richard*, and later delivered two damaging broadsides in spite of frantic signals. Water rose steadily in *Richard's* hold. A rumor buzzed that Jones had been killed, and his chief gunner, thinking the *Richard* was about to sink, began to shout for quarter. Jones knocked him cold with a well-thrown pistol. But Pearson had heard the cries. He called over to ask if Jones were ready to strike. Infuriated, Jones roared in reply, *"I have not yet begun to fight!"* (Samuel Eliot Morison points out that according to Lt. Richard Dale, who first recorded this famous phrase, Jones uttered it immediately after the first collision between the two ships, before grappling. According to Jones' own memoir, he answered Pearson's query, "I have not yet thought of it, but am determined to make you strike.")

Part of this was sheer bravado, but Jones did have a desperate strategy. While his three remaining guns nibbled at *Serapis'* mainmast, one of his seamen, on his own accord, Jones recounted, crawled to the British main top and began to lob grenades onto the deck. He sent some through an open hatchway and set off a powder cartridge. The explosion killed some 20 British sailors and burned others, and now occasional cries of "Quarter" came from *Serapis*.

The British prisoners aboard *Richard*

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had been released and were manning the pumps. One of them escaped to *Serapis* to inform Pearson that his enemy was sinking. If the British could hold on, he said, Jones must surely strike. But Pearson knew his mast was going. Shortly before 10:30 he tore down the British ensign he had nailed up and stepped to *Richard*'s deck to offer Jones his sword. Almost as he did so, the mast toppled.

Jones returned the sword and invited Pearson to the ruins of his cabin for a glass of wine. They must have gulped it, for now fire and water threatened both ships. At one point flames licked inches from *Richard*'s magazine. As work began on clearing the wreckage of *Serapis*' mast, *Richard*'s pumps were manned in a losing battle. By the evening of September 24, it was obvious that she was beyond saving. Jones transferred the wounded to other vessels and moved his flag to *Serapis*. At 10 P.M. he gave the order to abandon ship.

By dawn on September 25 water had almost reached the lower deck. Midshipman Fanning attempted to recover what he could of the officers' personal effects before leaving. He noted, "What havoc! Not a piece of them could be found as large as a continental dollar."

At the last minute, Jones sent Fanning to recover some papers, but as the midshipman reached *Richard*, "with her topsails aback and the water running in and out at her lower deck ports," he instinctively ordered his boat away. Just in time, for "we got off about four rods from her when she fetched a heavy pitch into a sea and a heavy roll, and disappeared instantaneously." Jones watched with "inexpressible grief," then headed for Holland in *Serapis*.

Bonhomme Richard went down somewhere northeast of Flamborough Head. Today she would be—if anything remains—merely a sediment-covered hump on the bottom of the North Sea. Using modern technology such as sidescan sonar and magnetometers (to locate the cannon), expeditions recently have tried to locate the wreck, but so far have failed. The National Underwater Marine Agency (a private organization founded by Clive Cussler, author of *Raise the Titanic!*, dedicated to locating and raising sunken ships) plans to try again.

When Jones arrived in the harbor of Texel, in Holland's West Frisian Islands, the British ambassador immediately claimed that since the United States were not a recognized government, Jones was an outlaw. While the neutral Dutch government hemmed and hawed, was by turns friendly and hostile, the Dutch populace idolized Jones.

Jones returned to America in 1781 in command of *Ariel*, laden with military supplies, and to a hero's welcome. En route he had a skirmish with an enemy vessel, his last battle under the American flag. His next command was to be *America*, then building in Portsmouth, but by the time she was launched, Congress had given her to France. After the war Jones lived in Paris (except for a brief stint in Catherine the Great's navy) where he died in July 1792, a forgotten man.

The British were annoyed that Jones had been treated as a hero in Amsterdam. As for Captain Pearson, he was returned to England, where a court-martial exonerated him and praised him for saving the convoy. He was eventually knighted for the action. Jones is reported to have commented, "Let me fight him again . . . and I'll make him a lord."

In this fiery re-creation painted by Richard Paton, *Serapis* is at left, obscuring all but the bow of *Bonhomme Richard*. *Alliance*, closing from right, is firing at *Richard*; in distance are *Countess of Scarborough* and *Vengeance*.

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A collector finds toys are not meant only for children

By Athelstan Spilhaus

Scientist who spent a career "playing" with satellites, bathythermographs, now delights in hand-held windups

A sample of the author's toy collection crowds the surface of a billiard table he bought especially for the purpose. His favorites are hand-sized mechanical toys.

In a richly rewarding life that the United States has given this immigrant, I have participated in putting up spaceships and satellites. I have invented the bathythermograph, which turned out to be very useful in the exploration of the oceans. I have designed my space clock that tells lots of different times and takes lots of time to set, and the comfortometer that tells you if you are comfortable or not and turns out to be useless but very amusing, and I have a U.S. patent on ice skates for the tropics (left to your imagination).

I regard all these as toys, though some were my "work," some just "play." But I have always been fortunate enough to be unable to distinguish between my work and play. Now I play very hard at finding toys for my collection so that I can work them. There's a billiard table in the toy room with no cues or balls, a greensward for the toys to play on safely.

I have studied the anatomy of toys; old, very sick toys go into intensive care where they get new limbs to walk or new muscles to move, and sometimes I per-

Spilhaus, a world-famous oceanographer profiled in our December 1971 issue, added three rooms to his house for toys.

A tin bucking bronco throws its rider over and over again. Made around the turn of the century by Lehmann, a German toy maker, it is spring-wound.

form miracle surgery to bring to life toys that in the course of their ecstatic capers have lost their heads.

The word toy may come from the Dutch *tuig*—tools, things or stuff—or, as once suggested, from the Danish *toeve,* meaning to stay, to tarry. The variety of toys is almost limitless. They may be large or miniature, lifelike or caricatures. Some are static, such as dolls' houses and furniture, to be admired and cherished rather than used; others are dynamic, mechanical toys that you can put into action. From autos to dolls, diamonds to games, toys are anything that enable us to tarry during the fast whip of ordinary life.

But we can't have them all. I find myself drawn to the wonderful mechanical ones about the size of the human hand. They can be held in the hand, worked by hand. Many old toys operate by generating steam or using electricity; modern moving toys use batteries. But perhaps the most intriguing are those based on the simplest mechanical principles which have lasted through the centuries. These toys use gears, wheels, swinging pendulums, gravity, centrifugal force or balance. The hand may be used directly with pull-and-push toys and string climbers. Other toys store the hand's energy in a spring, sand, water, a flywheel or compressed air.

What is appealing is the color, the beauty of line, form and shape, the humor of caricature, the charm of miniaturization. Some embody grace of rhythm, while the jerky antics of others evoke our laughter. They do things that we cannot do in real life, thus keeping us in touch with fantasy.

Toys stimulate the imagination, and are enormously satisfying because they take the place of the real thing that is unobtainable. They can bring a whole circus onto a little table and exotic characters can bring the world into your hand.

Like science fiction, toys show the shape of things to come as in the balloons, zeppelins and airplanes made in the 19th century. They can do all kinds of things that real-life machines cannot, even violate "good engineering principles" because they don't have to be efficient. Many toys use sudden reversals of motion to achieve comic effects. In real life, this would be like moving forward in your car and then jamming it into reverse again and again.

Toys reflect the hopes, fears and prejudices of their times, sometimes better than written history. Man's aspiration to fly led to charming toys; for example, small balloons support rowboat gondolas with men in them. A witch or jack-in-the-box brings squeals of terror. The host of toys depicting black dancers and minstrels around the turn of the century reflects the stereotypes and prejudices of the times. A rare toy actuated by sand shows a man at a forge and another hammering on an anvil. The objects being heated and beaten are the guillotined heads of French aristocrats. The grisly motto is, *"Ici on reforge les têtes des familles chez M. Lustucire"* (Here they are reforging the heads of the families at Mr. Lustucire's). The back of the toy is signed Jean Curé de Ste. Croix de Lauze, 1791.

Industrious rubber monkey beats on its drum when a rubber bulb is squeezed.

Sometimes history helps us date a toy. A beautiful little tin balloon that ascends a string bears a sailor waving an American flag with 45 stars on it. Thus it was made between 1896, when Utah joined the Union, and 1907, when Oklahoma become the 46th state.

The first use of the wheel may have been in a toy. In fact, the material expression of newly discovered physical principles often began as a plaything. Many times toys depicting engines of war preceded the real ones. Buck Rogers' ray gun antedates modern laser weapons by 30 or 40 years. Dick Tracy's wrist radio similarly appeared before miniature solid state electronics made practical beepers and walkie-talkies that allow work to interrupt our playtime. Mechanical robot toys are all humanized. The real robots of industry resemble them not at all.

Mechanical toys are basically the same as they were one or two centuries ago. A walking person is an inverted pendulum

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Double exposure shows a sailor, powered by a wound rubber band, rowing a boat.

Made in this country around 1930, the boat does work in water, but tends to rust.

In another multiple exposure, the robot on swing breaks into smile at top of arc.

These French acrobats, tumbling down inclined ladder, work entirely by gravity.

Little man appears to crank wheel when sand is poured into the hopper on top.

where the body swings from side to side as the feet move to and fro. The body is the pendulum bob. Jamming from forward to reverse with the resulting inertial shocks is the basic principle of toys where two cocks fight, a steamroller moves back and forth or a donkey-pulled cart jerks, causing the donkey to kick and buck.

Many old and new toys store the hand's energy by spinning a flywheel so that the toy proceeds on its own. Flywheel storage of energy is now contemplated for slowing down and accelerating buses and subway trains that stop and start frequently.

Gravity toys in which sand, marbles or water are put by hand into an elevated container, and work the mechanism as they trickle down, are the counterparts of hydroelectric power where falling water generates energy. The monkey that is actuated by compressed air produced by squeezing a rubber bulb uses the same principle as the noisy jackhammers that dig up our streets.

Windup spring toys, the most versatile, are all derived from spring-driven clocks of the Middle Ages: they are "clockwork" toys (p. 44). Springs are never used to propel real vehicles but are common in their tiny counterparts.

When the energy of the hand is stored, there must be some form of governor that releases the power at the right rate. Small orifices let sand and water fall steadily and not dump all at once. Pendulums and escapements prevent springs from springing. Air resistance is also used to control the unwinding of a spring. In a carousel, the figures in gondolas themselves provide the air resistance to make them whirl around smoothly. In other windups, a swiftly rotating fan regulates the speed. Some need no governors since the friction of running over the floor or table or moving through water is in itself a governor.

Toy boats—called "putt-putts" because of the noise made when they alternately suck water and expel steam from a heated chamber—preceded practical jet propulsion by almost a century. Hero of Alexandria invented an engine, a spherical boiler whirled by steam jets, 2,000 years ago. The mysteriously opening temple doors and singing artificial birds of Hellenic times were water-actuated, but toys moved by falling water are not common, probably because they are messy and subject to rust.

The simplest hobbyhorse, a broomstick with a horse's head on it, was galloped by children rich in imagination but poor in coin, whereas in the complex automata of lifelike, life-size dolls that drew pictures, played pianos and performed magic tricks, the imagination was in the mind of the toy maker and the coin in the princely personage's purse.

Two automata that poke fun bipartisanly were arcade penny-in-the-slot toys of the Gay Nineties. The Democratic donkey talks, waggles its ears, opens its mouth and makes its decision by twirling a wheel of chance, then talks again to explain it away. The Republican elephant, by stereotype more literate, flips a book at random and waves his trunk when the decision is not to his liking. The distinction between so-called automata and mechanical toys lies merely in the length

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5. Encouraging solid-waste exchanges

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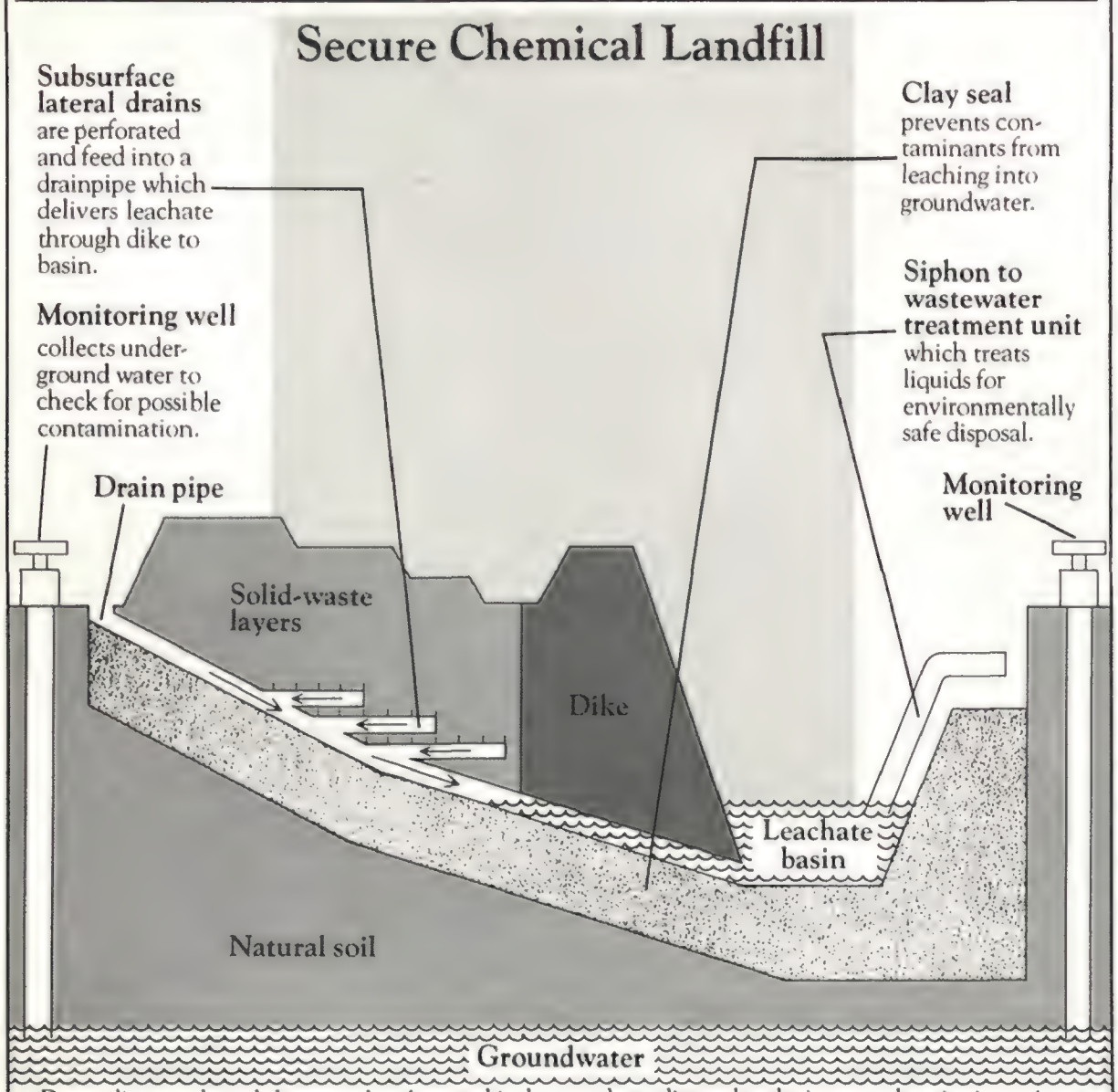
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Depending on the solid waste, the chemical industry selects disposal techniques such as incineration, by-product recovery, stabilization or secure landfill design to protect the environment.

America's Chemical Industry

The member companies of the Chemical Manufacturers Association

of the series of repeated motions: the automata go on much longer.

Very interesting are those toys that are not repetitive and thus bridge the gap between mechanical toys and games of chance. These must have randomness, the hardest thing to achieve in a mechanical device—to make the outcome unpredictable. A fine example is a horse-race toy (quite modern, 1920s) where a rapidly rotating square shaft shoots ball bearings up slots to propel the horses forward. A beautiful 100-year-old, hand-painted tin knight occasionally spears rings as his horse trots around. The randomness is provided by an eccentric wheel that causes him to post, making his lance go up and down so he misses as often as not.

Colorful hand-held, hand-operated, hand-wound toys are my favorites. If, in addition to these visual and tactile virtues, a toy portrays people or animals and adds the further wonder of tinkling music or animal noises, this is the epitome. I have a beloved lion with fluffy fur that winds up and roars ferociously just before it pounces.

A few extraordinary toys bring Man and his pet animal together. There are, of course, supersonic whistles, synthetic dog bones that squeak or noisemakers to call your favorite bird. I have a *serinette*, a little hand-operated barrel organ that plays high notes from tiny organ pipes. It was used by ladies of the 18th century, principally in France, to train pet canaries to sing.

We learn from toys how little the amusements of children have changed; how little the amusements of adults differ from those of children, except for purity of delight; and how toys are the additive to preserve our childish enchantment with magic, wonder and play. Historically, toys were never intended to be just for children.

Those who have lost touch with fantasy often ask me what a toy is worth. It is true that many toys, particularly old and rare ones, command a high price. Collectors spend their lives searching. But toys are worth only as much as you cherish them, admire them, play with them and derive pleasure from them. I have quite an investment in toys that pays interest daily in the golden coin of joy.

A tin toy made about 80 years ago by French maker Martin has Dutch maid spilling a set of dishes. We do not know whether some national slur was intended.

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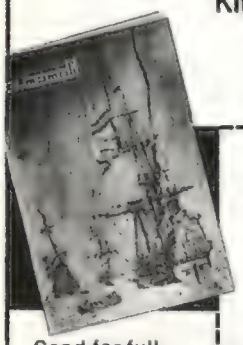

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Book reviews

The Sculpture of Leonard Baskin
Irma B. Jaffe
(Viking, $30)

This is a remarkable book about the life and work of a most remarkable sculptor. The book is remarkable because Professor Jaffe, Chairman of the Fine Arts Department at Fordham, has closely examined almost every major piece of sculpture Baskin has made, along with a lot not so major, has meticulously dredged up and illustrated those related works from the past—especially the distant past of, for example, Egypt, Sumer, Mesopotamia and China—and, finally, is not at all afraid to take issue with the artist himself on the essential questions of what his work means.

Professor Jaffe's previous works have been on that Connecticut Yankee, John Trumbull, and on the real Stella, namely

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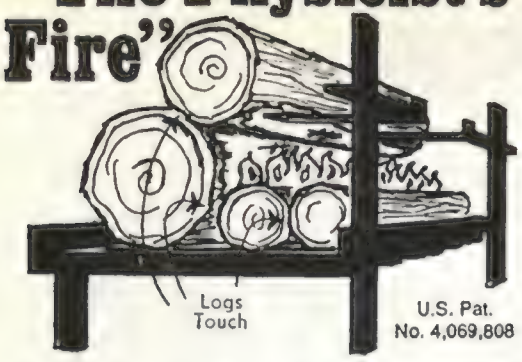

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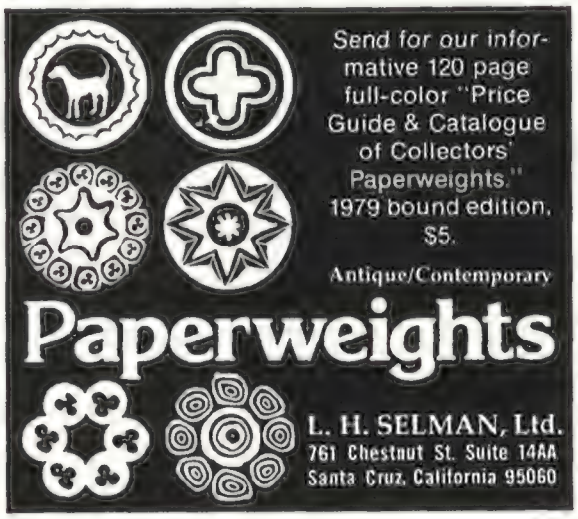

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Joseph, the American Futurist—both of them safely dead when she began her work. Baskin, on the contrary, was and, to the benefit of us all, still is cantankerously alive. He disagrees with much that Jaffe says about his work and, more important, has simply been around to comment on what he has been up to, what he thinks of what she has been up to, what the whole American mid- and late-20th-century art scene adds up to.

It doesn't add up to much, according to Baskin, and that's a large part of his value. Even if he weren't a significant sculptor and printmaker, Baskin would still be of great value because he has been able to take an informed, detached position from the Abstract Expressionist hysteria and, in his talk and occasional writings, give us all a position from which to observe that overwhelming phenomenon without being overwhelmed.

This, of course, has been a negative virtue, though an invaluable one: as we know from the examples of such academicians as Meissonier and Bouguereau, it is important not to get so carried away with the taste of one's own time as to mistake it for eternal verity. Positively, Baskin carried on the tradition of figurative sculpture and sculpture with meaning in terms of the human adventure, predicament, tragedy, and simply standing there. He did so when figurative sculpture was more or less officially regarded as—that wonderful word—*retardataire*, a deliberate and treasonous step backward from the spontaneous joys of Abstract Expressionism.

But the sculptor "has a settled conviction that painting and sculpture must mediate between artist and viewer some moral insight about human experience and is convinced that abstractions cannot do this."

Baskin is a meditative, contemplative artist and his work compels us to join him in those activities. His interpretation of Abraham's attempt to sacrifice Isaac is a very disturbing work, deliberately so. The clumsiness of father and son, even of the ram on the table altar, suggests that the two patriarchs are as bound by their own commitments as is the beast ready for slaughter. The piece is by no means either a paean of praise or a simple gasp of horror. It is both, and more. It reminds us that while the sculptor acknowledges "no official connection" with Judaism, he did go to Yeshiva as a

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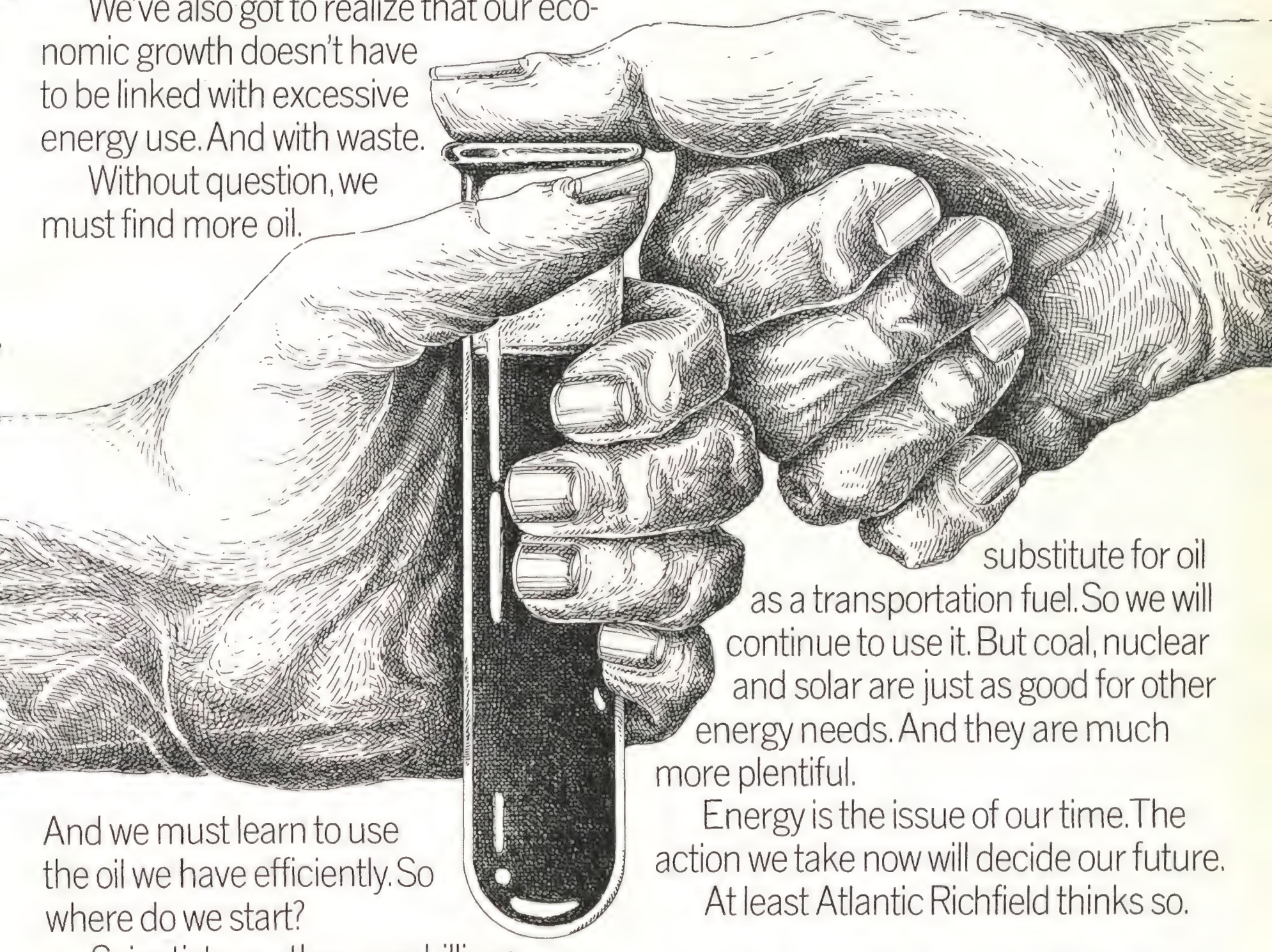

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child, practicing for some years the intellectual art of scriptural interpretation.

The late religious painter, André Girard, was once complained to by a parishioner of a church in which he had recently installed a large Crucifixion. "I find your painting painful," she said. "Madame," said the painter, "it was a painful occasion." For Baskin, a great deal of our lives and our legends are painful occasions. He thinks about that pain and cuts his thought into wood or casts it into burning bronze. We look at his work, share his thoughts, and are helped to endure.

—Frank Getlein
Critic and author

The Poisoning of Michigan
Joyce Egginton
(Norton, $13.95)

The poisoning of Michigan began in May 1973 in the small town of St. Louis. That month, employees of Farm Bureau Services, the largest agricultural feed plant in the state, began mixing what they thought was magnesium oxide into a batch of animal feed. But the substance was not magnesium oxide—it was a fire retardant chemical containing polybrominated biphenyl (PBB), one of the most toxic substances ever synthesized.

Farm Bureau Services distributed the contaminated feed to farmers throughout the state. Nine months later, the mixup was discovered. As Joyce Egginton observes in *The Poisoning of Michigan,* the result was "the biggest chemical disaster and the worst man-made agricultural catastrophe in United States history." A recent report by the Surgeon General and the Library of Congress' Congressional Research Service succinctly pointed out the ultimate outcome of the PBB mixup: "Number of People Affected: 8.5-9.0 million people (the population of the State of Michigan)."

Egginton's remarkable book tells the story of this tragedy of the chemical age. Her three years of work has resulted in a meticulously researched and smoothly written book which unravels the complicated story of the discovery of the PBB mixup and the effects it had on the farmers and residents of Michigan. It is a tale filled with calamity and irony.

Consider dairy farmer Rick Halbert, one of the first to be affected by the toxic feed, and the man whose persistence

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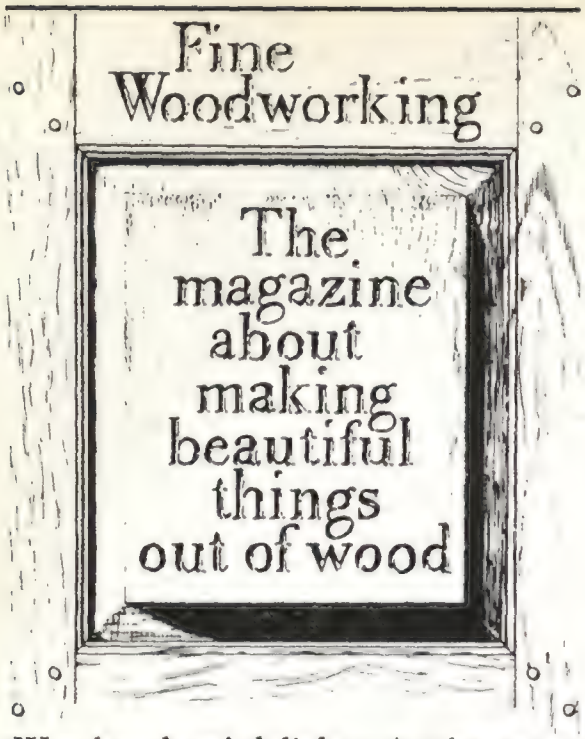

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led to the discovery that PBB was the cause of the sickness and death that plagued his cattle. Halbert was a chemical engineer who had quit his job at the corporate headquarters of Dow Chemical in Midland, Michigan, to run his own farm. It was Halbert who suggested to Farm Bureau Services the idea of adding magnesium oxide (which helps cattle digest food) to animal feed.

And then there is Michigan Chemical Corporation, the manufacturer of both magnesium oxide and PBB. Michigan Chemical was the nation's only manufacturer of PBB, beginning production in 1969. Other chemical manufacturers, including Dow and DuPont, refused to produce PBB because of its extreme toxicity. Michigan Chemical's trade name for magnesium oxide—the name printed on the outside of the bags sent to Farm Bureau Services—was Nutrimaster. The company's trade name for PBB was Firemaster. One employee of Farm Bureau Services responsible for mixing animal feed testified in court that he could not distinguish between the words "Nutrimaster" and "Firemaster" on the poorly marked bags.

PBB is one of a group of halogenated hydrocarbons developed in American commercial chemical laboratories. The list of some of the other halogenated hydrocarbons reads like a who's who of problem chemicals: DDT, vinyl chloride, Tris, kepone, chlordane, aldrin, mirex. Until production of PBB ended in November 1974, Michigan Chemical Corporation turned out some 12 million pounds of the substance. PBB was used as a fire retardant owing to its ability to bond itself to a substance such as plastic without changing the substance's composition. Among other things, PBB was added to television sets, hair dryers, typewriters, textiles, automobile upholstery and telephones.

After the PBB mixup was discovered, some 500 Michigan farms were quarantined and about 25,000 cattle, 1.5 million chickens and thousands of hogs, sheep, goats and horses were slaughtered. Health researchers under the direction of Dr. Irving J. Selikoff of the Mount Sinai Medical Center in New York City conducted a study in November 1976 that compared 1,029 Michigan farm residents with a group of Wisconsin farm families. The study found that nearly one-third of the Michigan group suffered adverse health effects that could have been caused by PBB contamination.

The reseachers found that the Michigan group had an unusual number of medical complaints, including inexplicable memory loss, swollen and painful joints, sleep problems and abdominal pain. When asked by reporters two months after the tests if he would eat bacon and eggs from Michigan each morning, Selikoff replied, "I would have to ask not just about bacon and eggs, but the milk that's put into the bread, the butter that's put on the bread, the cream that is used to make sauces. . . ."

Egginton's *The Poisoning of Michigan* is, simply, a complete book. Nowhere does Egginton, New York correspondent for *The Observer* of London, fall prey to a syndrome exhibited in many environmental books in which the writer becomes more important than the story. She does not inject herself into the book. Her descriptions of the main players are brief, but are penetrating and insightful. *The Poisoning of Michigan* is a highly

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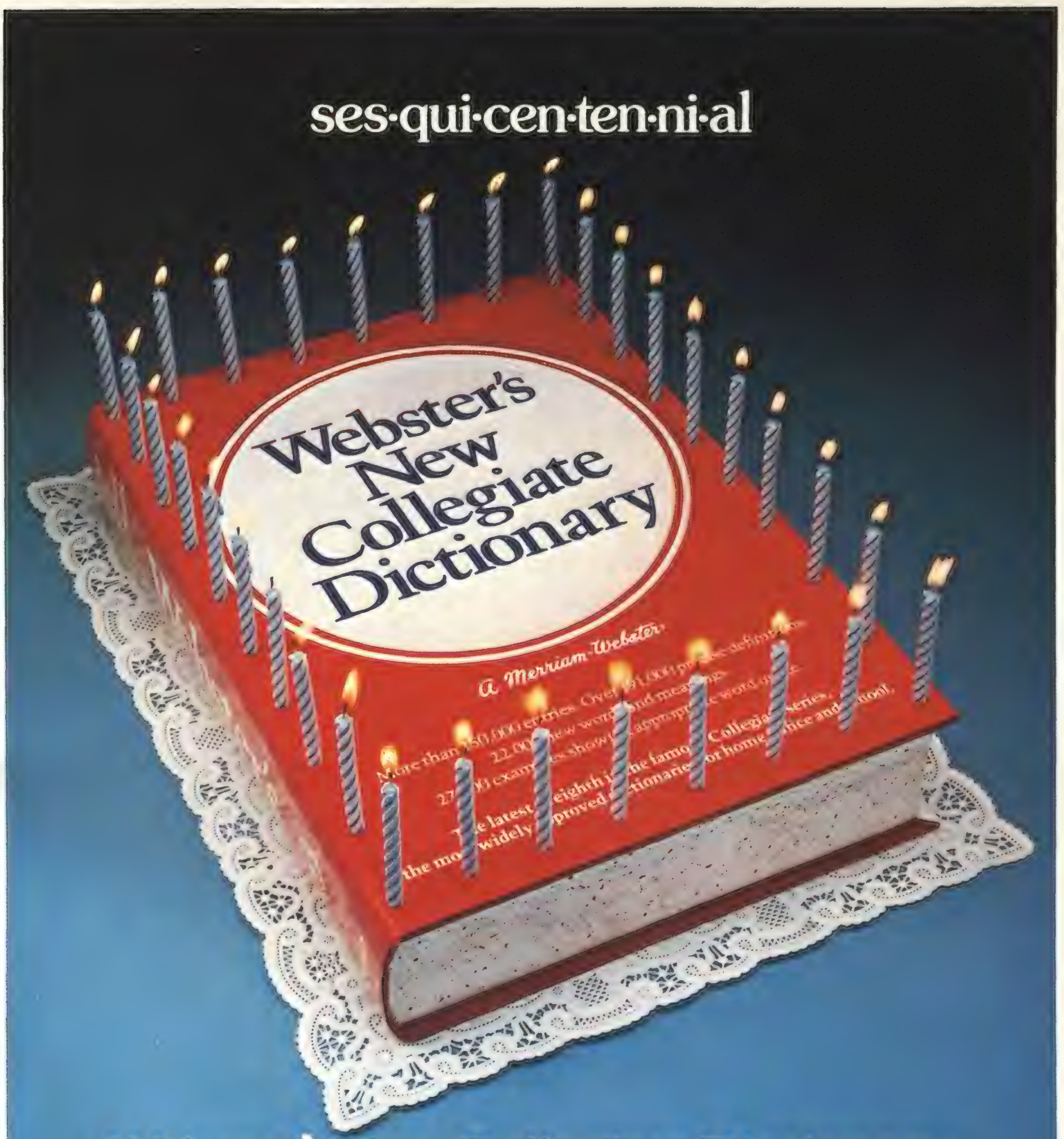

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—*Marc Leepson*
Staff writer, Editorial Research Reports

A Palace for a King: The Buen Retiro and the Court of Philip IV
Jonathan Brown and J. H. Elliott
(Yale University, $29.95)

If historians hundreds of years from now were to re-create through available documents the architecture, decoration and use of Camp David as a retreat for U.S. Presidents, what might they discover about American life and politics in the 20th century? In *A Palace for a King,* two historians of our own time reconstruct how and why the early 17th-century Buen Retiro, Philip IV's part-time retreat and pleasure palace, was built, embellished and used. Theirs is an effort to uncover the spirit, values and cultural attitudes during the golden age of Spanish art. It was a period in history vastly different, yet in some ways evocative of our own.

Above all, it was a time of paradoxes, which, simply put, is Jonathan Brown's and J. H. Elliott's theme. Spain, during its golden age, was the era of the prince as protector of the faith, guardian of the church and ruler of a great empire, and a time of unusual artistic and cultural vitality. Yet this was also a time of rebellions, power rivalries and economic devastation at home, warfare, defeat and political decline abroad.

The Buen Retiro, with its treasures, pomp and pageantry, was intended—somewhat in the spirit of political television commercials—to proclaim and propagandize the greater glory of the ruling monarchy, "the majesty of kingship, and no king on earth was called to a higher mission than the king of Spain. Philip was the heir to the great tradition of Hispanic kingship which began in the mists of antiquity. . . and was transmitted by way of the Visigoths and the Catholic monarchs to his glorious progenitors of the House of Austria."

Most of the 800 paintings created or collected for the palace were didactic in intent, recounting tales of princely triumph and rectitude in the face of "Heresy, Discord and Treachery, better known . . . as the Dutch, the English and the French," as the authors put it. "The king would patronize the arts and the arts would glorify the king." Among the artists, playwrights and poets who participated in this drama were Velázquez,

Olivares: his goals were to serve his king and bring honor to his family.

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Rubens, Poussin, the playwright Calderón and the set designer Cosimo Lotti.

As its title would indicate—it is simple enough for a children's tale—*A Palace for a King* tells a readily understandable, sometimes engrossing story. The book is handsomely laid out with 156 black-and-white photographs. Its chief protagonist is a hero-villain, the complex and contradictory Count-Duke of Olivares, who ruled while Philip IV reigned. Count-Duke Olivares rose to power with the accession of the 16-year-old Philip IV ("Now everything is mine," he had said as Philip III lay on his deathbed) and devoted himself to the restoration of the monarchy to its former stability and glory. "Austerity, discipline, the restoration of the old moral values—these were the watchwords of Olivares's campaign." There was great resistance to reform, especially among the old grandees, who despised the upstart favorite. "There were too many vested interests, too much insistence on privilege and status. . . ." Olivares' byword was service, "I have neither father, child nor friend except for him who serves the king well."

Olivares also mastermined every detail of the lavishly appointed Buen Retiro, which was widely criticized in its time, both as a wasteful indulgence and as insufficiently imposing architecture. Planned in haste and built haphazardly of poor materials over a ten year period, by 1640 the Buen Retiro covered an area almost half as large as the entire city of Madrid, on whose outskirts it had taken shape. Behind the unpretentious, fairly undistinguished facades, the interiors were a "paragon of real magnificence."

Spain's golden age coincided with the building or rebuilding of a host of European palaces, among them Versailles, the Louvre, Fontainebleau, the Pitti in Florence, the Barberini in Rome, St. James's and Whitehall in London. And "If a growing division between 'court' and 'country' was a major element in Europe's political turmoils of the mid-17th century, then the Buen Retiro takes its place in a wider European story of how that division grew."

Unlike these other monuments of the time, the Buen Retiro's heyday was short-lived. Beleaguered by domestic and international turmoil and defeat, Olivares resigned in 1643. Two years later, "the madness that had hovered over him finally descended, and he died, his mind gone, on July 22, 1645." With Olivares' departure from the scene, the palace quickly fell into disrepair.

The Retiro of today, say the authors, is not the Retiro built by the king and his minister. "They built a royal pleasure-palace, set amidst spacious gardens, for the enjoyment of a great royal court. The palace was largely destroyed in the Peninsular War, and the gardens, utterly transformed, have become a large municipal park."

The authors present the building, its treasure and times with sufficient dispassion, but conclude that "The Retiro was . . . designed as a monumental diversion. It might serve to divert attention from political reality to political imagery." It also diverted huge sums, "painfully extracted from an impoverished populace," for the "needs of state to create an oasis of splendor in the midst of misery."

Andrea O. Dean
Senior Editor, Articles, *AIA Journal*

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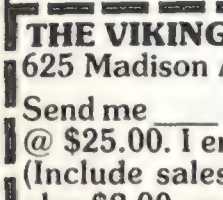

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by Tui De Roy Moore
Introduction by Peter Matthiessen

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Smithsonian highlights

Decoupage hot-air balloon dangles amid the *Trees of Christmas.*

What's in a name? In the case of two Smithsonian museums, new names confirm old roles. Congressional legislation has changed the National Collection of Fine Arts to the National Museum of American Art. A suitable change, according to Director Joshua Taylor, who said the museum has long focused "on the serious study, collecting and exhibiting of American art."

The National Museum of History and Technology has been renamed the National Museum of American History. The change, said Director Roger Kennedy, represents the museum's "basic mission—to illuminate, through collections, exhibitions, research, publications and educational programs, the entire history of the United States. . . ."

From December 26-31, these newly named halls of American history will be filled with cookies and crafts, music and mime, part of the annual Christmas and Hanukkah celebrations. (All Smithsonian museums will be closed Christmas Day.) Of special interest is the festive line-up of the 12 decorated *Trees of Christmas* (right), a display organized annually by the Office of Horticulture.

Tucked away in two cases is a charming collection of Christmas and New Year's greeting cards. Curator John Hoffman cites 1843 as the generally accepted year of the "first true" Christmas card, created by artist John C. Horsley for Sir Henry Cole, director of the Victoria and Albert Museum in London.

Special December events

Freer Gallery of Art
Turkish Art—New exhibit features textiles, paintings, jades.
Rimpa Screens—Six Japanese screens.
Four Popular Beauties of the "Floating World": Osen, Ofugi, Ohisa, Okita (December 9, 8:30 P.M.)—Lecture.

National Museum of American History
Holiday Celebration (December 26-31)—Special activities.
Clockwork Universe (through February 22)—Some 120 German clocks (p. 44).
The Christians (December 3, 4, 10, 11, 17, 18, January 7, 8; 12:30 P.M.)—Series of films, free.

Air and Space Museum
Double Eagle II/Atlantic Fever (opens in December)—The story of transatlantic ballooning, including the balloon that made the first manned crossing in 1978.
Christmas Stars (December 6, 9 A.M.)—Monthly sky lecture.

Cooper-Hewitt Museum (New York)
"Now I lay me down to eat": A Salute to the Unknown Art of Living (through February 22)—Objects of everyday life.
Central Park: Original Drawings (through February 1).

Hirshhorn Museum & Sculpture Garden
A Hirshhorn Holiday! (December 6, 10 A.M.—2 P.M.)—Annual family day featuring films, musicians, puppets.
André Masson: Prints (through February 22)—Works by this French Surrealist.
Avant-Garde in Russia, 1910-1930: New Perspectives (through February 15)—Comprehensive collection (p. 68).

Museum of African Art
Traditional Art of Cameroon, Angola and Gabon (opens December 17)—Selections from the Permanent Collection.

Renwick Gallery
American Porcelain (through August 16).
Poetry Reading (December 12, 12:15 P.M.)—Elizabeth Ann James reads.

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Arrah now, my Honey, and that 'shet you!

From Portrait Gallery's *Code Duello*: Mason Locke Weems' 1818 engraving illustrated antidueling treatise, "God's Revenge Against Duelling."

National Portrait Gallery

The Code Duello in America (December 18-April 19)—Portrays the gentleman's art of dueling (above).
Silhouettes from Cheswick (December 20; 11 A.M.-1 P.M., 2-4 P.M.)—As part of NPG's Portraits in Motion series, Helen and Nel Laughon will cut your silhouette.

National Museum of American Art

Art for All: American Print Publishing Between the Wars (December 4-May 10)—Works include some coveted classics.
Eisenstaedt: Germany (ends January 4).
The World of David Gilmour Blythe (December 3, 2 P.M.)—Lecture by guest curator Dr. Bruce W. Chambers.

Museum of Natural History

Coral Reef—Spectacular living coral reef.
South American Christmas (December 26, 27; 1-4 P.M.)—Crafts demonstrations and musical performances.

Radio Smithsonian

This music and conversation program is broadcast weekly on some 65 stations across the country. (The schedule is different in Washington, D.C.)
Popular Culture in the Soviet Union (week of December 7).
The Conquest of Land—the emergence of terrestrial life; *A Victorian Horticultural Extravaganza* (week of December 14).
The '80s at the Air and Space Museum (week of December 21).
Live from the Smithsonian!—performers from the New York City Opera; *Hair Through the Ages; Falcons on the Smithsonian Roof* (week of December 28).

Smithsonian events

For tickets to December resident associate events, call 357-3030:
What Hope for Tortoises? (December 15, 6 and 8:30 P.M.).
The Avant-Garde in Russia, 1910-1930 (December 13)—All-day seminar (p. 68).
Romaine Brooks (December 4, 6 P.M.).
Clockwork Universe (December 10, 8 P.M.)—The rise of German clockmaking.
The Indiana *Scenario* (December 11, 8 P.M.)—Analysis of freighter sunk in 1858.
Dutch Painting in the Age of Rembrandt (December 16, 8 P.M.).

For tickets to performing arts events, call 357-1500:
Little Theatre of the Deaf (December 4-January 4)—A&I Discovery Theater, Wednesdays through Sundays.
Romantic Chamber Ensemble (December 5, 6, 7; 7 P.M.).
20th Century Consort (December 8, 8 P.M.; December 14, 7 P.M.).
Messiah (December 16-19, 8 P.M.).
Bobby Hutcherson and Walt Dickerson (December 20, 21, 6 P.M.)—Jazz.

Regional events

The National Associate Program's Regional Events 1981 series begins February with week-long lectures and workshops in Tampa and St. Petersburg. Those who spend the winter in these areas but receive the magazine elsewhere may request invitations by writing: Regional Events, 1208 A&I, Smithsonian, Washington, D.C. 20560.

Smithsonian Institution Traveling Exhibition Service

SITES circulates exhibitions to hundreds of cities outside Washington, D.C. To sponsor a show in your community, write to Eileen Harakal, SITES, Smithsonian Institution, Washington, D.C. 20560. Here are some December exhibits:

West Palm Beach, Florida (November 29-December 28)—*Jacob Jordaens,* Norton Gallery and School of Art.

Champaign, Illinois (December 20-February 15)—*The Ratner Collection of Judaean Antiquities,* Krannert Art Museum.

South Bend, Indiana (December 20-January 18)—*Cut on Wood,* Art Center of South Bend.

Springfield, Massachusetts (December 6-January 4)—*Edison and the Electrical Age,* Springfield Science Museum.

Bloomington, Minnesota (December 20-January 25)—*Mexico As Seen By Her Children,* Normandale College.

Jamaica, New York (December 6-January 4)—*The World of Haitian Painting,* Jamaica Center for the Performing and Visual Arts.

Allentown, Pennsylvania (November 22-January 4)—*The Phillips Collection: In the Making, 1920-1930,* Allentown Art Museum.

Wilkes-Barre, Pennsylvania (December 13-January 11)—*Paper as Medium,* Sordoni Art Gallery.

Arlington, Texas (December 13-January 11)—*Quintessential Quilts,* Fielder Museum.

Midland, Texas (December 20-January 18)—*Inuit Sculpture,* Museum of the Southwest.

Athens, West Virginia (November 22-December 21)—*Polish Posters,* Concord College.

Membership benefits when visiting the Smithsonian

Associates Reception Desk: Information and special publication, 10 A.M.-4 P.M. daily in the castle. Ask about orientation slide talk on 13 Smithsonian museums.

Associates Lounge: Quiet relaxation, 10 A.M.-5:30 P.M. daily in the castle.

The Court: Members' dining room, in the Museum of Natural History.

Discounts: In most Smithsonian shops with membership card.

For previsit information: Send postcard or phone Associates Reception Center, Smithsonian Institution, Washington, D.C. 20560 (202-357-2700 or, for hearing impaired, TDD 202-357-1729). Allow two weeks for receipt.

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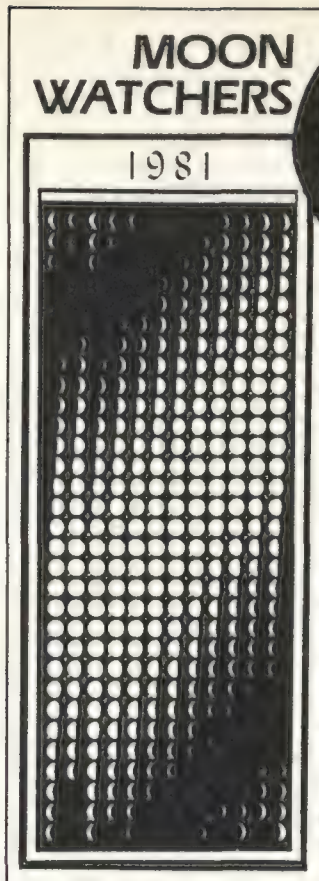

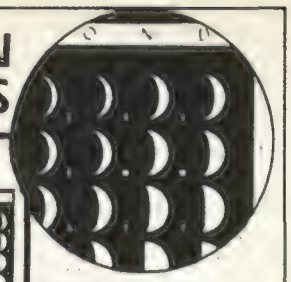

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On the road with SITES

From Albert Einstein to decorative shopping bags, Mamluks to moths, some 150 Smithsonian-organized exhibitions are making the rounds to local museums around the country (p.177). These traveling shows are coordinated by curators and specialists, some connected with Smithsonian, some not, working with staffers from SITES—Smithsonian Institution Traveling Exhibition Service.

SITES shows are displayed at major museums such as Smithsonian's Natural History Museum, which opens a show on the Islamic art of the Mamluks in May. And they also go to small towns such as Logan, Kansas, where a SITES quilt exhibit doubled the traffic at the Dane G. Hansen Museum. "That's pretty good for Logan," said director Renee McElroy, who has already scheduled *Berlin Porcelain* (right) for autumn of 1982.

SITES books more than 1,000 openings a year, from elaborate fine arts shows with fragile objects to panels of enlarged photos. Monthly rental fees range from $100 to $40,000—mostly to cover production, packing, shipping and insurance costs. "We're not a profit-making arm of the Smithsonian," explains Peggy Loar, SITES director. "We're a support service to museums. We help them get exhibits they couldn't normally arrange themselves." What are some of the most popular choices? "Textiles, prints, air and space themes—those shows book well," says Loar. Also, there's great interest in black studies shows, such as *Black American Graphics* (right).

One SITES objective is to encourage exhibitors to add creative touches to traveling shows. The Dallas Health and Science Museum built cavelike halls for *Ice Age Art*. A bike rodeo publicized the bicycle show *Ride On!* at the Montgomery (Alabama) Museum of Art.

Also traveling with SITES shows are catalogs, brochures and educational aids. The board game "Bright Ideas" was designed to complement *Edison and the Electrical Age*. *Quintessential Quilts* is accompanied by a quilt pattern kit, an aid that produces both quilts and comments. Observed one sewing sixth grader: "I learned how to lose my patience. . . ."

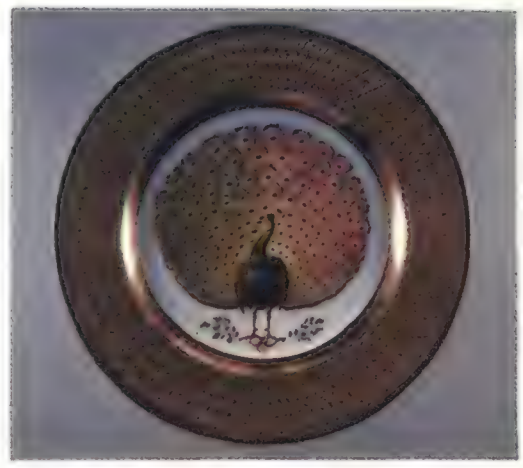
—Carol Simons

Julia Ward Howe travels with Portrait Gallery photos.

Krushenick's work is among 30 Hirshhorn collages on tour.

Black American Graphics work by Margo Humphrey is also SITES poster.

Packing shows such as *Berlin Porcelain* is major job.



A 96-page color catalog shows plate from *Sèvres Porcelain*.

Show with Ecuadorian embroidery opens at Renwick, then tours.

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(signed) Joseph J. Bonsignore
Acting Publisher

Additional reading

Clocks (p. 44)

The Clockwork Universe: German Clocks and Automata 1550-1650, edited by Klaus Maurice and Otto Mayr, Neale Watson Academic Publications (New York), 1980

Geared to the Stars by Henry C. King, University of Toronto Press, 1978

Clocks and Culture 1300-1700 by Carlo M. Cipolla, W. W. Norton & Co., 1978

Avalanche control (p. 56)

Avalanche Handbook by Ronald I. Perla and M. Martinelli jr., U.S. Department of Agriculture Forest Service, 1976

The Avalanche Hunters by Montgomery M. Atwater, Macrae Smith (Philadelphia), 1968

Russian avant-garde (p. 68)

The Avant-Garde in Russia, 1910-1930: New Perspectives, Los Angeles County Museum of Art (catalog of the exhibition). Available from The MIT Press, 28 Carleton Street, Cambridge, Massachusetts 02142

Great Experiment: Russian Art 1863 to 1922 by Camilla Gray, Abrams, 1962

Artists in Revolution by Robert C. Williams, Indiana University Press (Bloomington), 1977

Salvation Army (p. 78)

Marching to Glory by Edward H. McKinley, Harper & Row, 1980

Soldiers Without Swords: A History of the Salvation Army in the United States by Herbert A. Wisbey, Macmillan, 1956

The General was a Lady by Margaret Troutt, A. J. Holman Co., 1980

The History of the Salvation Army by Robert Sandall *et al.*, Thomas Nelson and Sons, 1947—in progress (six volumes to date)

Cactus (p. 94)

The Cacti of Arizona by Lyman Benson, University of Arizona Press, 1969

Succulents in Peril, edited by D. R. Hunt (Supplement to the International Organization for Succulent Plant Study Bulletin, Vol. III, No. 3), 1974

"Cacti: Bizarre, Beautiful, But in Danger," by Lyman Benson, *National Parks & Conservation Magazine*, July 1975

Flying boat (p. 106)

Empire: The Life, Legend, and Madness of Howard Hughes by Donald L. Barlett and James B. Steele, W. W. Norton & Co., 1979

The Bashful Billionaire: The Story of Howard Hughes by Gerber Albert Benjamin, L. Stuart, 1967

Fusion (p. 128)

"Fusion Energy in Context: Its Fitness for the Long Term" by John P. Holdren, *Science*, April 14, 1978

Report on the Department of Energy Magnetic Fusion Program by the Fusion Review Panel, Energy Research Advisory Board, Department of Energy, August 1980

"Progress Toward a Tokamak Fusion Reactor" by Harold P. Furth, *Scientific American*, August 1979

John Paul Jones (p. 139)

John Paul Jones: A Sailor's Biography by Samuel Eliot Morison, Atlantic-Little, Brown, 1959

John Paul Jones: Fighter for Freedom and Glory by Lincoln Lorenz, U.S. Naval Institute (Annapolis), 1943

John Paul Jones' Memoir of the American Revolution, translated and edited by Gerald W. Gawalt, Library of Congress, 1979

Mechanical toys (p. 157)

American Antique Toys by Bernard Barenholtz, Abrams, 1980

Dictionary of Toys Sold in America by Ernest and Ida Long, privately published. Available from Ernest A. Long, P. O. Box 272, Mokelumne Hill, California 95245

Come to Colonial Williamsburg this winter and get the royal treatment.

Warm your winter with the noble fare from the kitchens of taverns that were favorites of 18th-century Williamsburg—Chowning's, King's Arms and Christiana Campbell's.

Try a steaming game pie, a traditional Brunswick stew, or a bowl of hot peanut soup.

Sit down to a sumptuous feast at the five-star Williamsburg Inn, where the attentive staff will have you thinking you're the Royal Governor. Or explore the menus of other superb establishments like the Williamsburg Lodge and the Cascades.

Take advantage of the special opportunity winter offers for a more intimate encounter with Williamsburg's colonial past.

Guided tours are less hurried. They let you look longer and more carefully at aspects of this 18th-century town that are often overlooked. What's more, during winter you will have plenty of time to browse in Williamsburg's unusual shops.

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Domestic Study Tours

These tours offer specialized guidance and expertise generally unavailable to persons traveling on their own:

Christmas at the Smithsonian—December 5-7: Gala tree-trimming party; includes visit to new exhibit at the National Gallery, *The Search for Alexander.*

Virgin Islands Adventure—January 12-21 or January 21-30: Chartered sailboats provide bases for exploring the Caribbean and spectacular coral reefs.

Yellowstone in Snow—February 20-March 1: Cross-country skiing in Jackson, Wyoming, and Yellowstone National Park to discover the splendors of nature.

Arts Weekend—March 6-8: View collections of several Smithsonian museums on special tours led by curators and staff.

Tetons Winter Ecology—March 31-April 8: In cooperation with the Grand Teton Environmental Center, study the delicate balance of nature in winter. Includes cross-country skiing, day and evening programs.

New York—April 2-5 or April 9-12: Exciting weekend features new American wing at Metropolitan Museum of Art.

Jefferson's Virginia—April 8-14: Trace development of American architecture with visits to Williamsburg, Charlottesville and Richmond.

Mississippi—April 27-May 4: Relive the history of antebellum South with visits to plantations in Vicksburg and Natchez.

Big Bend—May 2-10: Hike the spectacular canyon trails in this southwest Texas wilderness park.

Illinois Archaeology—May 24-31: In the Illinois River valley, join dig that spans nearly 10,000 years. Includes instruction, lab work and field trips.

Washington "Anytime" Weekend: Choose any weekend to visit your choice of Smithsonian museums, spend two nights at Loew's L'Enfant Plaza Hotel or Hyatt Regency Washington, each close to the Mall, and see other sights in the city by Tourmobile. Reservations and payments at least ten days prior to arrival.

Foreign Study Tours

These tours range in size from small group experiences to charter adventures and vary in price from low cost to deluxe, depending on the type of travel, destination visited and length of trip:

Antarctica—December 31-January 20: Join prominent lecturers for a study voyage; breathtaking views of glaciers, icebergs, penguins and whales.

Baroque Winter: Vienna, Salzburg, Munich—January 4-18: Walking tours, lectures, opera and a Viennese ball.

Mayan Mexico: The Yucatán Peninsula—January 8-20 or February 3-15: A complete tour of these extraordinary ruins.

Guatemala—January 21-February 1 or February 18-March 1: Explore Tikal and other Mayan ruins with an archaeologist.

Kenya—February 5-22: Incomparable wildlife is observed in old safari tradition. Seminars in Nairobi and in the field—Masai Mara, Samburu, Kilaguni.

Micronesia: An Adventure Tour—February 9-28: Unique opportunity to visit the remote, wondrously lovely and unspoiled islands of the South Pacific.

A Hike in New Zealand—February 13-28: Take the "finest walk in the world" along the Milford Track from Lake Te Anau to Milford Sound; also included: Mt. Cook National Park, Queenstown, Erewhon Park and Christchurch.

New Zealand—February 18-March 6: Tour includes talks on natural history, Maori heritage, and a home visit.

Zapotec and Mayan Mexico—March 4-16 or March 18-30: Oaxaca and Zapotec sites of Monte Albán and Mitla; San Cristóbal de las Casas; Palenque, Uxmal and other Mayan ruins in the Yucatán.

Morocco—March 7-22: The medinas and souks of Morocco from Rabat, Meknès, Fez and Marrakesh across the Atlas Mountains to the Sahara. Encompasses the stark Roman ruins of Volubilis, the markets with their textiles and the modern Morocco of Casablanca.

Ecuador and the Galápagos Islands—March 22-April 2: Shipboard seminars enhance observations of rich plant, animal and bird life.

Mediterranean Spring—April 25-May 6: Join lecturers aboard MTS *Argonaut* for a study of Peloponnesus, Sicily, Malta and Salerno among other sites.

Portugal—May 5-19 or October 6-20: Four days in Lisbon; choice of travel to Alto Alentejo with Evora and fortified hill towns of Estremoz; or old Lusitania with Porto, Coimbra and Viseu.

London—May 11-25: Museums, seminars, walking tours and theater; five days visiting the English countryside.

Odyssey of Flight—May 24-June 8: Paris Air Show, the Musée de l'Air, Britain's Shuttleworth Collection and more, in the company of curators from National Air and Space Museum.

Malaysia, Borneo and Singapore—May 25-June 12: Kuala Lumpur, Penang and Malacca—plus a choice of travel to the seldom-visited East coast, the remote National Park; or an exciting excursion to the jungles of Borneo.

Wild Highlands of Scotland—May 28-June 13: In cooperation with Aigas Field Centre, study natural history and wildlife of central Highland glens.

Alpine Countryside—June 6-21 or September 12-27: Stay in an Austrian mountain village and learn about this picturesque historic area.

Waterways of France—June 28-July 9: Aboard the MTS *Argonaut,* visit historic ports, walled cities, chateaux and vineyards with expert lecturers.

The Lakes of Finland—July 11-26: An extravaganza of festivals and cultural happenings.

People's Republic of China: 13 tours from April through October with five different itineraries.

Write National Associates, A&I 1278, Smithsonian Institution, Washington, D.C. 20560 for specific tour/seminar brochures or call (202)

in Washington

Selected Studies Seminars

Treat yourself to a popular program at the Smithsonian that combines excellent speakers and small, specially arranged "behind-the-scenes" tours. Choose from:

The Splendor of Byzantium—February 15-20: The magnificent arts of Constantinople and the vast Byzantine Empire in illustrated lectures, along with tours of the exquisite collections at Dumbarton Oaks (Harvard University's research center) and Walters Art Gallery (Baltimore).

Model Airplanes: Then and Now—February 22-27: Foremost talents discuss every aspect of aeromodeling with an abundance of film clips, slides and actual models at the Air and Space Museum.

American Painting in the 19th Century—March 22-27: Exploration of the achievements of acknowledged masters such as Copley, Cole, Church, Homer, Ryder and Eakins. Includes tours of the Capitol, National Gallery of Art and National Museum of American Art.

American Antique Furniture—March 22-27: Connoisseurship of masterpieces, 1650-1840. Includes color slides of great collections, detection of fakes, care of antiques, and tours of the elegant Diplomatic Reception Rooms at the Department of State and the Winterthur Museum.

World War II Aviation—March 29-April 3: The outstanding aeronautical staff of the National Air and Space Museum and guest experts offer new insights into how the major air forces of the world came into being, and how quantum jumps in aviation production and performance were achieved. Includes tours to see many of the only surviving World War II planes.

Naval History—**April 26-May 1:** Famous authorities and authors trace the evolution of the U.S. Navy from the age of sail to nuclear power. Includes films and tours of the Smithsonian's Naval History collections, the Navy Memorial Museum and the U.S. Naval Academy.

Historic Horticulture—May 3-8: Celebrate spring in the lovely 18th-20th century gardens of Mount Vernon, the National Arboretum, Dumbarton Oaks and the du Pont estates of Longwood and Winterthur.

357-2477 (tours) or (202) 357-2475 (seminars).

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By Michael Kernan

Kid vs. coal furnace, a grating winter's tale

About this time of year a lot of householders begin to think about converting to gas, or possibly wood, and the heating-oil people get nervous. You know because they send you cheerful brochures on The Story of Oil with pictures of Alaska, Texas, Canada, the North Sea, in fact almost any place except Iran.

Now for some of us, this is not an amazing event. It is very difficult to amaze people over 50, for they have learned that everything happens in cycles.

I remember being terribly excited when my father said we were going to convert. To oil. From coal.

I figure I must have spent one-seventh of my childhood in the cellar tending the coal furnace.

It was a life-style.

Every day before school and every night after homework I went down there to feed the iron baby. It was about the size of a Cadillac resting on its side, except it wasn't shiny.

First, you grabbed the arm-length iron handle at the side and jiggled it up and down to make the grates move, shaking down the dead ashes. The grates were made of iron too. Nobody ever had to tell me what was meant by a grating sound.

Then you shoveled the ashes into some old garbage cans. When there were too many ashes to fit (meaning that you had failed to empty the cans recently), you dumped the rest into a bushel basket standing nearby. This had a tendency to burst into flame, so you squirted water on it from a handy garden hose.

That in turn created a great cloud of fine white ash, which covered everything, including you in your school clothes.

There was an iron rod called a poker, five feet long with a loop handle at one end and a 90-degree bend at the other, with a point. When you got a clinker, a hard chunk of residue that stuck in the grates, you had to pick the furnace's teeth, blundering down through the bed of hot coals with the poker.

After a while the poker got white-hot. Then you could pull it out and carve your name yet again on the raw pine boards of the coal bin, making lovely woodsmoke. Or you could plunge it into a pail of water, which would promptly hiss and boil. I learned a lot about physics in the cellar.

Finally you shoveled in the new coal. A kid knew about coal in those days. There were rice, pea, chestnut, egg and I forget what other sizes, and we knew them by sight. Which was no great thing, when you come to think of it.

Every kid also knew the sound of coal rushing down the battered chute through a cellar window beneath the bedroom. More often than not, the noise would interfere with your dreams in various complicated ways. You got to know all the stages, from the first tentative patter to the great roar to the final gasps as the deliveryman helped the last bits from the uptilted truck bed with his shovel.

Our town had a coal shed. (Every town had a coal shed.) It was built over the railroad siding in vaguely Gothic style with a clerestory. There were glassless windows high in the clerestory for some reason. I suppose they were for the train to blow smoke through, but as far as I was concerned, nobody ever used them except to throw snowballs at.

Our dog liked coal. He would steal a lump from the cellar and lie out on the lawn chewing it. On a winter night I could see him there, nearly covered by snow from the blizzard, contentedly worrying his piece of coal. He preferred egg coal.

One autumn I used some old orange crates for kindling to start the furnace. Eventually the wood ashes were shaken down along with the coal and spread on the driveway.

Ashes were perfect for covering the icy spots and potholes. Coal ashes often have hunks of slag in them, sharp as lava. Handling coal ashes is something like handling the inside of a Butterfinger bar. But orange crates are something else. Orange-crate ashes have nails in them. The summer after that particular autumn our car had a flat every two weeks. I got so I could change a tire in four minutes.

Coal was part of life. Even *The Shadow* on the radio was sponsored by Blue Coal. Then one summer we switched to oil, and coal vanished as fast as buggy whips.

I hear coal is coming back now. The Anthracite Institute of Harrisburg, Pennsylvania, is getting hundreds of calls from all over the Northeast.

"They are asking where they can get bagged anthracite," says the Institute. "It's about the same price as wood, and it's got far more BTUs."

That is to say, it stays hotter longer.

It doesn't smell as marvelous. But you knew that. Actually it doesn't smell much at all.

Coal is coming back. Wonderful. I'm for it. Just don't ask me to go down in the cellar again.

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